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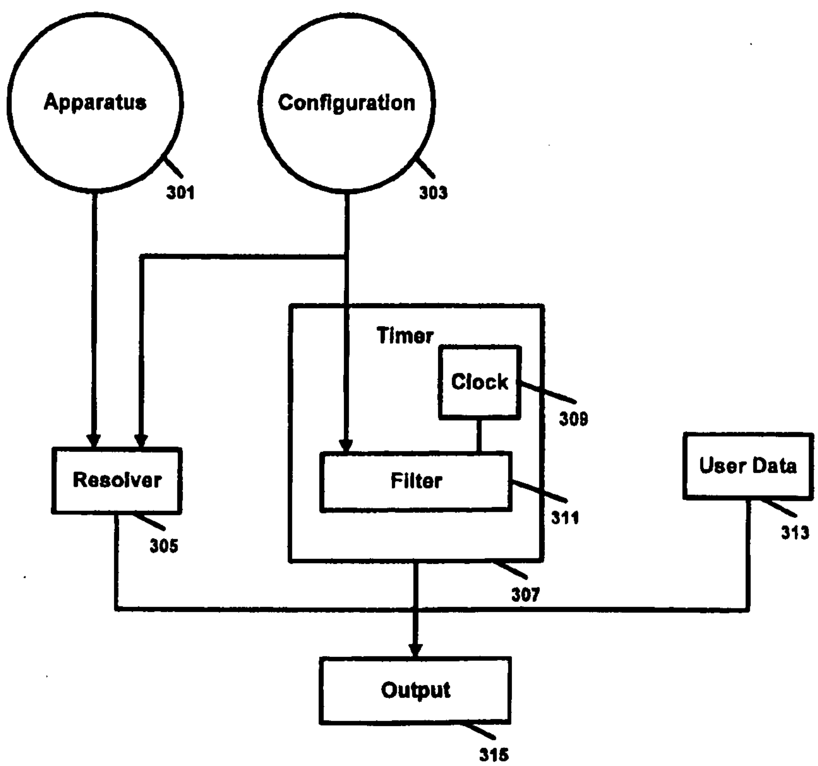
(54) Title: AUTOMATED SYSTEM FOR IMAGE ARCHIVING

(57) Abstract

A method for producing universal image tracking implementations. This invention provides a functional implementation, from which any image-producing device can construct automatically generated archival enumerations. This implementation uses an encoding schemata based on location numbers, image numbers, and parent numbers, anticipated by the formal specifications. Location numbers encode information about logical sequence in the archive, image numbers encode information about the physical attributes of an image, and parent numbers record the conception date and time of a given image's parent. Parent-child relations are algorithmically derivable from location and parent number relationships, thus providing fully recoverable, cumulative image lineage information. Encoding schemata are optimized for use with all current and arriving barcode symbologies to facilitate data transportation across disparate technologies (e.g., negatives to prints to computers). The implemented system is seamlessly compatible with traditional database "key-driven" recovery systems, as well as with portable decoding systems capable of reading self-contained databases directly from images.



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Title: Automated System for Image Archiving

Reference to Related Application

This application claims the benefit of U.S. Provisional Application No. 60/035,485 filed January 13, 1997 entitled "Automated Image Archiving System."

Field of Invention

This invention relates generally to archive and documentation of data. More particularly this invention is a universal image tracking system wherein generations of images can be related one to another and to original images that contributed to a final image without significant user intervention.

Background of the Invention

Increasingly, images of various types are being used in a wide variety of industrial, digital, medical, and consumer uses. In the medical field, telemedicine has made tremendous advances that now allow a digital image from some medical sensor to be transmitted to specialists who have the requisite expertise to diagnose injury and disease at locations remote from where the patient lies. However, it can be extremely important for a physician, or indeed any other person to understand how the image came to appear as it does. This involves a knowledge of how the image was processed in order to reach the rendition being examined. In certain scientific applications, it may be important to "back out" the effect of

a particular type of processing in order to more precisely understand the appearance of the image when first made.

Varieties of mechanisms facilitate storage and retrieval of archival information relating to images. However, these archival numbering and documentation schemes suffer from certain limitations. For example, classificatory schemata are used to facilitate machine sorting of information about a subject ("subject information") according to categories into which certain subjects fit. Additionally tracking information, that is, information concerning where the image has been or how the image was processed, is also used together with classificatory schemata.

However, relying on categorizing schemata is inefficient and ineffective. On the one hand, category schemata that are limited in size (i.e. number of categories) are convenient to use but insufficiently comprehensive for large-scale applications, such as libraries and national archives. Alternatively if the classificatory schemata is sufficiently comprehensive for large-scale applications, it may well be far too complicated, and therefore inappropriate for small scale applications, such as individual or corporate collections of image data.

It is also an approach to provide customizable enumeration strategies to narrow the complexity of large-scale systems and make them discipline specific. Various archiving schemes are developed to suit a particular niche or may be

customizable for a niche. This is necessitated by the fact that no single solution universally applies to all disciplines, as noted above. However, the resulting customized archival implementation will differ from, for example, a medical image to a laboratory or botanical image archive. The resulting customized image archive strategy may be very easy to use for that application but will not easily translate to other application areas.

Thus, the utility provided by market niche image archiving software simultaneously makes the resulting applications not useful to a wide spectrum of applications. For example, tracking schemata that describes art history categories might not apply to high-tech advertising.

Another type of archival mechanism is equipment-specific archiving. In this implementation a particular type of image device, such as a still camera, a video camera, a digital scanner, or other form of imaging means has its own scheme for imprinting or recording archival information relating to the image that is recorded.

Thus, using different image-producing devices in the image production chain can cause major problems. For example, mixing traditional photography (with its archive notation) with digital touch-up processing(with its own different archive notation). Further, equipment-specific archive schemes do not automate well, since multiple devices within the same archive may use incompatible enumeration schemata.

Certain classification approaches assume single device input. Thus, multiple devices must be tracked in separate archives, or are tracked as archive exceptions. This makes archiving maintenance more time consuming and inefficient. For example, disciplines that use multiple cameras concurrently, such as sports photography and photo-journalism, confront this limitation.

Yet other archive approaches support particular media formats, but not multiple media formats simultaneously occurring in the archive. For example, an archive scheme may support conventional silver halide negatives but not video or digital media within the same archive.

Thus, this approach fails when tracking the same image across different media formats, such as tracking negative, transparency, digital, and print representation of the same image.

Yet another archive approach may apply to a particular state of the image, as the initial or final format, but does not apply to the full life-cycle of all image. For example, some cameras time- and date-stamp negatives, while database software creates tracking information after processing. While possibly overlapping, the enumeration on the negatives differs from the enumeration created for archiving. In another example, one encoding may track images on negatives and another encoding may track images on prints. However, such a state-specific approach makes it difficult automatically to

track image histories and lineages across all phases of an image's life-cycle, such as creation, processing, editing, production, and presentation.

Thus, tracking information that uses different encoding for different image states is not particularly effective since maintaining multiple enumeration strategies creates potential archival error, or at a minimum, will not translate well from one image form to another.

Some inventions that deal with recording information about images have been the subject of U.S. patents in the past. U.S. Patent No. 5579067 to *Wakabayashi* describes a "Camera Capable of Recording Information." This system provides a camera which records information into an information recording area provided on the film that is loaded in the camera. If information does not change from frame to frame, no information is recorded. However, this invention does not deal with recording information on subsequent processing.

U.S. Patent No. 5455648 to *Kazami* was granted for a "Film Holder or for Storing Processed Photographic Film." This invention relates to a film holder which also includes an information holding section on the film holder itself. This information recording section holds electrical, magnetic, or optical representations of film information. However, once the information is recorded, it is to used for purposes other than to identify the original image.

U.S. Patent No. 5649247 to *Itoh* was issued for an "Apparatus for Recording Information of Camera Capable of Optical Data Recording and Magnetic Data Recording." This patent provides for both optical recording and magnetic recording onto film. This invention is an electrical circuit that is resident in a camera system which records such information as aperture value, shutter time, photo metric value, exposure information, and other related information when an image is first photographed. This patent does not relate to recording of subsequent operations relating to the image.

U.S. Patent 5319401 to *Hicks* was granted for a "Control System for Photographic Equipment." This invention deals with a method for controlling automated photographic equipment such as printers, color analyzers, film cutters. This patent allows for a variety of information to be recorded after the images are first made. It mainly teaches methods for production of pictures and for recording of information relating to that production. For example, if a photographer consistently creates a series of photographs which are off center, information can be recorded to offset the negative by a pre-determined amount during printing. Thus the information does not accompany the film being processed but it does relate to the film and is stored in a separate database. The information stored is therefore not helpful for another laboratory that must deal with the image that is created.

U.S. Patent 5193185 to *Lanter* was issued for a "Method and Means for Lineage Tracing of a Spatial Information Processing and Database System." This Patent relates to geographic information systems. It provides for "parent" and "child" links that relate to the production of layers of information in a database system. Thus while the this patent relates to computer-generated data about maps, it does not deal with how best too transmit that information along a chain of image production.

U.S. Patent No. 5008700 to *Okamoto* was granted for a "Color Image Recording Apparatus using Intermediate Image Sheet." This patent describes a system, where a bar code is printed on the image production media which can then be read by an optical reader. This patent does not deal with subsequent processing of images which can take place or recording of information that relates to that subsequent processing.

U.S. Patent No. 4728978 was granted to *Inoue* for a "Photographic Camera." This patent describes a photographic camera which records information about exposure or development on an integrated circuit card which has a semiconductor memory. This card records a great deal of different types of information and records that information onto film. The information which is recorded includes color temperature information, exposure reference information, the date and time, shutter speed, aperture value, information concerning

use of a flash, exposure information, type of camera, film type, filter type, and other similar information. The patent claims a camera that records such information with information being recorded on the integrated circuit court. There is no provision for changing the information or recording subsequent information about the processing of the image nor is there described a way to convey that information through many generations of images.

Thus a need exists to provide a uniform tracking mechanism for any type of image, using any type of image-producing device, which can describe the full life-cycle of an image and which can translate between one image state and another and between one image forming mechanism and another.

Summary of the Invention

It is therefore an object of the present invention to create an archival tracking method that includes relations, descriptions, procedures, and implementations for universally tracking images.

It is a further object of the present invention to create an encoding schemata that can describe and catalogue any image produced on any media, by any image producing device, that can apply to all image producing disciplines.

It is a further object of the present invention to implement to archival scheme on automated data processing means that exist within image producing equipment.

It is a further object of the present invention to apply

to all image-producing devices.

It is a further object of the present invention to support simultaneous use of multiple types of image-producing devices.

It is a further object of the present invention to support simultaneous use of multiple image-producing devices of the same type.

It is a further object of the present invention to provide automatic parent-child encoding.

It is a further object of the present invention to track image lineages and family trees.

It is a further object of the present invention to provide a serial and chronological sequencing scheme that uniquely identifies all images in an archive.

It is a further object of present invention to provide an identification schemata that describes physical attributes of all images in an archive.

It is a further object of the present invention to separate classificatory information from tracking information.

It is a further object of the present invention to provide an enumeration schemata applicable to an unlimited set of media formats used in producing images.

It is a further object of the present invention to apply the archival scheme to all stages of an image's life-cycle, from initial formation to final form.

It is a further object of the present invention to create

self-generating archives, through easy assimilation into any image-producing device.

It is a further object of the present invention to create variable levels of tracking that are easily represented by current and arriving barcode symbologies, to automate data transmission across different technologies (e.g., negative to digital to print).

These and other objects of the present invention will become clear to those skilled in the art from the description that follows.

Brief Description of the Invention

The present invention is a universal image tracking method and apparatus for tracking and documenting images through their complete life-cycle, regardless of the device, media, size, resolution, etc., used in producing them.

Specifically, the automated system for image archiving ("ASIA") encodes, processes, and decodes numbers that characterize images and image related data. Encoding and decoding takes the form of a 3-number association: 1) location number (serial and chronological location), 2) image number (physical attributes), and 3) parent number (parent-child relations).

Brief Description of the Drawings

Figure 1. Invention

Figure 1A. Overview of original image input

Figure 1B. Overview of lineage information generation

Figure 2. Formal specification
Figure 3 Encoding
Figure 4 Decoding
Figure 5 Implementation
Figure 6 Parent-child tree
Figure 7 ASIA

Detailed Description of the Invention

The present invention is a method and apparatus for formally specifying relations for constructing image tracking mechanisms, and providing an implementation that includes an encoding schemata for images regardless of form or the equipment on which the image is produced.

Referring to Figure 1 an overview of the present invention is shown. This figure provides the highest-level characterization of the invention. Figure 1 itself represents all components and relations of the ASIA.

Reference conventions. Since Figure 1 organizes all high-level discussion of the invention, this document introduces the following conventions of reference.

- Whenever the text refers to "the invention" or to the, *"Automated System for Image Archiving"*, it refers to the aggregate components and relations identified in Figure 1.
- Parenthesized numbers to the left of the image in Figure 1 **Invention** represent **layers** of the invention. For example, 'Formal specification'

represents the "first layer" of the invention.

In Figure 1 **Invention**, each box is a hierarchically derived sub-component of the box above it. 'ASIA' is a sub-component of 'Formal objects', which is a sub-component of 'Formal specification'. By implication, thus, ASIA is also hierarchically dependent upon 'Formal specification.' The following descriptions apply.

Formal specification 1. This represents (a) the formal specification governing the creation of systems of automatic image enumeration, and (b) all derived components and relations of the invention's implementation.

Formal objects 2. This represents implied or stated implementations of the invention.

ASIA 3. This is the invention's implementation software offering.

It is useful to discuss an overview of the present invention as a framework for the more detailed aspects of the invention that follow. Referring first to figure 1A an overview of the original image input process according to the present invention is shown. The user first inputs information to the system to provide information on location, author, and other record information. Alternatively, it is considered to be within the scope of the present invention for the equipment that the user is using to input the required information. In this manner, data is entered with minimum user interaction.

This information will typically be in the format of the equipment doing the imaging. The system of the present invention simply converts the data via a configuration algorithm, to the form needed by the system for further processing. The encoding/decoding engine 12 receives the user input information, processes into, and determines the appropriate classification and archive information to be in coded 14. The system next creates the appropriate representation 16 of the input information and attaches the information to the image in question 18. Thereafter the final image is output 20, and comprises both the image data as well as the appropriate representation of the classification or archive information. Such archive information could be in electronic form seamlessly embedded in a digital image or such information could be in the form of a barcode or other graphical code that is printed together with the image on some form of hard copy medium.

Referring to figure 1B the operation of the system on an already existing image is described. The system first receives the image and reads the existing archival barcode information 30. This information is input to the encoding/decoding engine 32. New input information is provided 36 in order to update the classification and archival information concerning the image in question. This information will be provided in most cases without additional user intervention. Thereafter the encoding/decoding engine

determines the contents of the original barcoded information and arrives at the appropriate encoded data and lineage information 34. This data and lineage information is then used by the encoding/decoding engine to determine the new information that is to accompany the image 38 that is to be presented together with the image in question. Thereafter the system attaches the new information to the image 40 and outputs the new image together with the new image related information 42. In this fashion, the new image contains new image related information concerning new input data as well as lineage information of the image in question. Again, such archive information could be in electronic form as would be the case for a digital image or such information could be in the form of a barcode or other graphical code that is printed together with the image on some form of hard copy medium.

Referring to Figure 2 the formal relations governing encoding **4**, decoding **5**, and implementation of the relations **6** are shown. Encoding and decoding are the operations needed to create and interpret the information on which the present invention relies. These operations in conjunction with the implementation of the generation of the lineage information give rise to the present invention. These elements are more fully explained below.

Encoding

Introduction. This section specifies the formal relations characterizing all encoding of the invention, as identified in

Figure 2 **Formal specification.**

Rather than using a "decision tree" model (e.g., a flow chart), Figure 3 uses an analog circuit diagram. Such a diagram implies the traversal of all paths, rather than discrete paths, which best describes the invention's, encoding relations.

Component descriptions. Descriptions of each component in Figure 3 **Encoding** follow.

Apparatus input **301** generates raw, unprocessed image data, such as from devices or software. Apparatus input could be derived from image data, for example, the digital image from a scanner or the negative from a camera system.

Configuration input **303** specifies finite bounds that determine encoding processes, such as length definitions or syntax specifications.

The resolver **305** produces characterizations of images. It processes apparatus and configuration input, and produces values for variables required by the invention.

Using configuration input, the timer 307 produces time stamps. Time-stamping occurs in 2 parts:

The clock **309** generates time units from a mechanism. The filter **311** processes clock output according to specifications from the configuration input. Thus the filter creates the output of the clock in a particular format that can be used later in an automated fashion. Thus the output from the clock is passed through the filter to produce a time-stamp.

User data processing **313** processes user specified information such as author or device definitions, any other information that the user deems essential for identifying the image produced, or a set of features generally governing the production of images.

Output processing **315** is the aggregate processing that takes all of the information from the resolver, timer and user data and produces the final encoding that represents the image of interest.

Decoding

Referring to Figure 4 the relationships that characterize all decoding of encoded information of the present invention are shown. The decoding scheme shown in Figure 4 specifies the highest level abstraction of the formal grammar characterizing encoding. The set of possible numbers (the "language") is specified to provide the greatest freedom for expressing characteristics of the image in question, ease of decoding, and compactness of representation. This set of numbers is a regular language (i.e., recognizable by a finite state machine) for maximal ease of implementations and computational speed. This language maximizes the invention's applicability for a variety of image forming, manipulation and production environments and hence its robustness.

Decoding has three parts: location, image, and parent. The "location" number expresses an identity for an image through use of the following variables.

generation	Generation depth in tree structures.
sequence	Serial sequencing of collections or lots of images.
time-stamp	Date and time recording for chronological sequencing.
author	Creating agent.
device	Device differentiation, to name, identify, and distinguish currently used devices within logical space.
locationRes	Reserved storage for indeterminate future encoding.
locationCus	Reserved storage for indeterminate user customization.

The "image" number expresses certain physical attributes of an image through the following variables.

category	The manner of embodying or "fixing" a representation, e.g., "still" or "motion".
size	Representation dimensionality.
bit-or-push	Bit depth (digital dynamic range) or push status of representation.
set	Organization corresponding to a collection of tabular specifiers, e.g. a "Hewlett Packard package of media tables.
media	Physical media on which representation occurs.
resolution	Resolution of embodiment on media.

stain	Category of fixation-type onto media, e.g. "color".
format	Physical form of image, e.g. facsimile, video, digital, etc.
imageRes	Reserved storage for indeterminate future encoding.
imageCus	Reserved storage for user customization.

The "parent" number expresses predecessor image identity through the following variables.

time-stamp	Date, and time recording for chronological sequencing.
parentRes	Reserved storage, for indeterminate future encoding.
parentCus	Reserved storage, for indeterminate user customization.

Any person creating an image using "location," "image," and "parent" numbers automatically constructs a representational space in which any image-object is uniquely identified, related to, and distinguished from, any other image-object in the constructed representational space.

Implementation

Referring to figure 5, the formal relations characterizing all implementations of the invention are shown. Three components and two primary relations characterize any implementation of the encoding and decoding components of the present invention. Several definitions of terms are apply.

"schemata" 51 are encoding rules and notations.

"engine " 53 refers to the procedure or procedures for processing data specified in a schemata.

"interface" 55 refers to the structured mechanism for interacting with an engine.

The engine and interface have interdependent relations, and combined are hierarchically subordinate to schemata. The engine and interface are hierarchically dependent upon schemata.

Formal objects

The present invention supports the representation of (1) parent-child relations, (2) barcoding, and (3) encoding schemata. While these specific representations are supported, the description is not limited to these representations but may also be used broadly in other schemes of classification and means of graphically representing the classification data.

Parent-child implementation

Parent-child relations implement the 'schemata' and 'engine' components noted above. The following terms are used in conjunction with the parent child implementation of the present invention:

"conception date" means the creation date/time of image.

"originating image" means an image having no preceding conception date.

"tree" refers to all of the parent-child relations descending from an originating image.

"node" refers to any item in a tree.

"parent" means any predecessor node, for a given node.

"parent identifier" means an abbreviation identifying the conception date of an image's parent.

"child" means a descendent node, from a given node.

"lineage" means all of the relationships ascending from a given node, through parents, back to the originating image.

"family relations" means any set of lineage relations, or any set of nodal relations.

A conventional tree structure describes image relations.

Encoding

Database software can trace parent-child information, but does not provide convenient, universal transmission of these relationships across all devices, media, and technologies that might be used to produce images that rely on such information. ASIA provides for transmission of parent-child information both (1) inside of electronic media, directly; and (2) across discrete media and devices, through barcoding.

This flexibility implies important implementational decisions involving time granularity and device production speed.

Time granularity & number collision. This invention identifies serial order of children (and thus parents) through date- and time-stamping. Since device production speeds for various image forming devices vary across applications, e.g.

from seconds to microseconds, time granularity that is to be recorded must at least match device production speed. For example, a process that takes merely tenths of a second must be time stamped in at least tenths of a second.

In the present invention any component of an image forming system may read and use the time stamp of any other component. However, applications implementing time-stamping granularities that are slower than device production speeds may create output collisions, that is, two devices may produce identical numbers for different images. Consider an example in which multiple devices would process and reprocess a given image during a given month. If all devices used year-month stamping, they could reproduce the same numbers over and over again.

The present invention solves this problem by deferring decisions of time granularity to the implementation. Implementation must use time granularity capable of capturing device output speed. Doing this eliminates all possible instances of the same number being generated to identify the image in question. In the present invention, it is recommended to use time intervals beginning at second granularity, however this is not meant to be a limitation but merely a starting point to assure definiteness to the encoding scheme. In certain operations, tenths of a second (or yet smaller units) may be more appropriate in order to match device production speed.

Specification

All images have parents, except for the originating image which has a null ('0') parent. Parent information is recorded through (1) a generation depth identifier derivable from the *generation* field of the location number, and (2) a parent conception date, stored in the parent number. Two equations describe parent processing. The first equation generates a parent identifier for a given image and is shown below.

Equation 1: Parent identifiers. A given image's parent identifier is calculated by decrementing the location number's *generation* value (i.e. the generation value of the given image), and concatenating that value with the parent number's parent value. Equation 1 summarizes this:

$$\textit{parent identifier} = \textit{prev(generation)} \bullet \textit{parent} \qquad (1)$$

To illustrate parent-child encoding, consider an image identified in a given archive by the following key:

B0106-19960713T195913JSA:1-19 S135F-OFCP@0100S:2T-0123 19960613T121133

In this example the letter "B" refers to a second generation. The letter "C" would mean a third generation and so forth. The numbers "19960713" refers to the day and year of creation, in this case July 13, 1996. The numbers following the "T" refers to the time of creation to a granularity of seconds, in this case 19:59:13 (using a 24 hour clock). The date and time for the production of the parent image on which the example image relies is 19960613T121133, or June 13, 1996

at 12:11:33.

Equation 1 constructs the parent identifier:

parent identifier = prev(generation) • parent

or,

parent identifier = prev(B) • (19960613T121133)

= A • 19960613T121133

= A19960613T121133

The location number identifies a B (or "2nd") generation image. Decrementing this value identifies the parent to be from the **A** (or "1st") generation. The parent number identifies the *parent* conception date and time, (19960613T121133). Combining these, yields the parent identifier A19960613T121133, which uniquely identifies the parent to be generation A, created on 13 June 1996 at 12:11:13PM (T121133).

Equation 2 evaluates the number of characters needed to describe a given image lineage.

Equation 2: Lineage lengths. Equation 2 calculates the number of characters required to represent any given generation depth and is shown below:

$$\mathit{lineage\ length} = \mathit{len(key)} + \left(\mathit{generation\ depth} - 1\right) * \mathit{len}\left(\mathit{parent\ identifier}\right) \qquad (2)$$

Example: 26 generations, 10^{79} family relations. Providing a 26 generation depth requires a **1** character long definition for *generation* (i.e. A-Z). Providing 1000 possible transformations for each image requires millisecond time

encoding, which in turn requires a **16** character long *parent* definition (i.e. gen. 1-digit, year-4 digit, month 2-digit, day 2-digit, hour 2-digit, min. 2-digit, milliseconds 3-digit). A 1 character long *generation* and 16 character long *parent* yield a 17 character long parent identifier.

Referring to Figure 6, the parent child encoding of the present invention is shown in an example form. The figure describes each node in the tree, illustrating the present invention's parent-child support.

601 is a 1st generation original color transparency.

603 is a 2nd generation 3x5 inch color print, made from parent 601.

605 is a 2nd generation 4x6 inch color print, made from parent 601.

607 is a 2nd generation 8x10 inch color internegative, made from parent 601.

609 is a 3rd generation 16x20 inch color print, made from parent 607.

611 is a 3rd generation 16x20 inch color print, 1 second after 609, made from parent 607.

613 is a 3rd generation 8x10 inch color negative, made from parent 607.

615 is a 4th generation computer 32x32 pixel RGB "thumbnail" (digital), made from parent 611.

617 is a 4th generation computer 1280x1280 pixel RGB screen dump (digital), 1 millisecond after 615, made

from parent 611.

619 is a 4^{th} generation 8.5x11 inch CYMK print, from parent 611.

This tree (Figure 6) shows how date- and time-stamping of different granularities (e.g., nodes 601,615, and 617) distinguish images and mark parents. Thus, computer screen-dumps could use millisecond accuracy (e.g., 615,617), while a hand-held automatic camera might use second granularity (e.g., 601). Such variable date,- and time-stamping guarantees (a) unique enumeration and (b) seamless operation of multiple devices within the same archive.

Applications

The design of parent-child encoding encompasses several specific applications. For example, such encoding can provide full lineage disclosure, and partial data disclosure.

Application 1: Full lineage disclosure, partial data disclosure

Parent-child encoding compacts lineage information into parent identifiers. Parent identifiers disclose parent-child tracking data, but do not disclose other location or image data. In the following example a given lineage is described by (1) a fully specified key (location, image, and parent association), and (2) parent identifiers for all previous parents of the given key. Examples illustrates this design feature.

Example 1: 26 generations, 10^{79} family relations.

Providing a 26 generation depth requires a 1 character long definition for *generation*. Providing 1000 possible transformations for each image requires millisecond time encoding, which in turn requires a **16** character long *parent* definition. A 1 character long *generation* and 16 character long *parent* yield a 17 character long parent identifier (equation 1).

Documenting all possible family relations requires calculating the sum of all possible nodes. This is a geometric sum increasing by a factor of 1000 over 26 *generations*. The geometric sum is calculated by the following equation:

$$\text{sum}=\frac{factor^{(generations\ +1)}-1}{factor\ -\ 1} \qquad (3)$$

or,

$$\text{sum}=\frac{1000^{(26+1)}\ -\ 1}{1000\ -\ 1}$$

$$=\frac{10^{81}\ -\ 1}{999}$$

$$= 1.00 \cdot 10^{79}$$

For 26 generations, having 1000 transformations per image, the geometric sum yields 10^{79} possible family relations. To evaluate the number of characters needed to represent a maximum lineage encoded at millisecond accuracy across 26 generations, the following equation is used (noted earlier):

```
lineage = len(key) + (generation) -1 * len(   parent )
length               (  depth    )          (identifier)
```

or,

$$\text{lineage length} = (100) + (26 - 1) * (17) = 525$$

Thus, the present invention uses **525 characters** to encode the maximum lineage in an archive having 26 generations and 1000 possible transformations for each image, in a possible total of 10^{79} family relations.

Example 2: 216 generations, 10^{649} family relations. The upper bound for current 2D symbologies (e.g., PDF417, Data Matrix, etc.) is approximately 4000 alphanumeric characters per symbol. The numbers used in this example illustrate, the density of information that can be encoded onto an internally sized 2D symbol.

Providing a 216 generation depth requires a 2 character long definition for *generation*. Providing 1000 possible transformations for each image requires millisecond time encoding, which in turn requires a 16 character long *parent* definition. A 2 character long *generation* and 16 character long *parent* yield an 18 character long parent identifier. To evaluate the number of characters needed to represent a maximal lineage encoded at millisecond accuracy across 216 generations, we recall equation 2:

$$\mathit{lineage\ length} = \mathit{len(key)} + \left(\begin{array}{c}\mathit{generation}\\ \mathit{depth}\end{array}\right) -1 * \mathit{len}\left(\begin{array}{c}\mathit{parent}\\ \mathit{identifier}\end{array}\right)$$

or,

$$\text{lineage length} = (100) + (216-1) * (18) = 3970$$

In an archive having 216 generations and 1000 possible modifications for each image, a maximal lineage encoding requires **3970 characters**.

Documenting all possible family relations requires calculating the sum of all possible nodes. This is a geometric sum increasing by a *factor* of 1000 over 216 *generations*. To calculate the geometric sum, we recall equation 3:

$$sum = \frac{factor^{(generations+1)} - 1}{factor - 1}$$

or,

$$\text{sum} = \frac{1000^{(216+1)} - 1}{1000 - 1}$$

$$= \frac{10^{651} - 1}{999}$$

$$= 1.00 \cdot 10^{649}$$

For 216 generations, having 1000 transformations per image, the geometric sum yields **10^{641} possible family relations**. Thus, this invention uses **3970 characters** to encode a maximal lineage, in an archive having 216 generations and 1000 possible transformations for each image, in a possible total of 10^{649} family relations.

Conclusion. The encoding design illustrated in **Application 1: Full lineage disclosure, partial data disclosure** permits exact lineage tracking. Such tracking discloses full data for a given image, and parent identifier data for a given image's ascendent family. Such design protects proprietary information while providing full data recovery for any lineage by the proprietor.

A 216 generation depth is a practical maximum for 4000 character barcode symbols, and supports numbers large enough for most conceivable applications. Generation depth beyond 216 requires compression and/or additional barcodes or the use of multidimensional barcodes. Furthermore, site restrictions may be extended independently of the invention's apparati. Simple compression techniques, such as representing numbers with 128 characters rather than with 41 characters as currently done, will support 282 generation depth and 10^{850} possible relations.

Application 2: Full lineage disclosure, full data disclosure

In direct electronic data transmission, the encoding permits full transmission of all image information without restriction, of any archive size and generation depth. Using 2D+ barcode symbologies, the encoding design permits full lineage tracking to a 40 generation depth in a single symbol, based on a 100 character key and a theoretical upper bound of 4000 alphanumeric characters per 2D symbol. Additional barcode symbols can be used when additional generation depth

is needed.

Application 3: Non-tree-structured disclosure

The encoding scheme of the present invention has extensibility to support non-tree-structured, arbitrary descent relations. Such relations include images using multiple sources already present in the database, such as occurring in image overlays.

Conclusion

Degrees of data disclosure. The invention's design supports degrees of data disclosure determined by the application requirements. In practicable measures the encoding supports:

1. Full and partial disclosure of image data;
2. Lineage tracking to any generation depth, using direct electronic data transmission;
3. Lineage tracking to restricted generation depth, using barcode symbologies, limited only by symbology size restrictions.

Further, ASIA supports parent-child tracking through time-stamped parent-child encoding. No encoding restrictions exist for electronic space. Physical boundaries within 2D symbology space promote theoretical encoding guidelines, although the numbers are sufficiently large so as to have little bearing on application of the invention. In all cases, the invention provides customizable degrees of data disclosure appropriate for application in commercial, industrial, scientific, medical, etc., domains.

Barcoding implementation

Introduction. The invention's encoding system supports archival and classifications schemes for all image-producing devices, some of which do not include direct electronic data transmission. Thus, this invention's design is optimized to support 1D-3D+ barcode symbologies for data transmission across disparate media and technologies.

1D symbology

Consumer applications may desire tracking and retrieval based on 1 dimensional (1D) linear symbologies, such as Code 39. Table 5 shows a configuration example which illustrates a plausible encoding configuration suitable for consumer applications.

The configuration characterized in Table 5 yields a maximal archive size of 989,901 images (or 19,798 images a year for 50 years), using a 4 digit *sequence* and 2 digit *unit*. This encoding creates 13 character keys and 15 character long, Code 39 compliant labels. A database holds full location, image, and parent number associations, and prints convenient location number labels, for which database queries can be made.

<generation>	=	1 character
<sequence>	=	4 digits
<date>	=	6 digits
<unit>	=	2 digits
constants	=	2 characters
Total	=	15 characters

Table 5: Configuration example

With such a configuration, a conventional 10 mil, Code 39 font, yields a 1.5 inch label. Such a label conveniently fits onto a 2x2 inch slide, 3x5 inch prints, etc. Note, that this encoding configuration supports records and parent-child relations through a conventional "database key" mechanism, not through barcode processing.

Conclusion. The ASIA implementation provides native 1D symbology support sufficient for many consumer applications. However, 2D symbology support is preferred since it guarantees data integrity. 2D symbology also provides greater capacity and so can support a richer set of functionality provided by the ASIA.

2D symbology

Comprehensive tracking suitable for commercial, industrial, and scientific applications is achievable electronically, and/or through 2 dimensional (2D), stacked matrix or full matrix symbologies, such as PDF417, Data Matrix, etc. These symbologies have adequate capacity to support complex implementations of the various archival and classification schemes presented.

Example application. 2D symbology can support a rich set of the present invention's encoding. The following examples present some of the possibilities.

1. **Parent-child tracking**. 2D symbology can support significant parent-child encoding including parent-child relations, lineage, tracking mechanisms, and derivative

applications.

2. **Copyright protection.** Combined with certification programs, 2D image encodings of this invention can enhance copyright protection. Referential tracking to production source can be provided on any image, which can include partial or full disclosure of image data. Encryption technologies can further enhance authentication control.

3. **Migration paths.** 2D symbology also includes important potential migration paths for encoding schemata in commercial and industrial image management. 2D applications may include arbitrary encryption; variable sizing; Reed-Solomon error correction (e.g., providing full data recovery with 50% symbol loss); printability through ink, invisible ink, etching, embossing, exposing (e.g., onto negatives or transparencies); and efficient scan rates suitable for automated film processing equipment.

In summary, 2D symbology can facilitate universal data transmission, regardless of the producing technology; or data transmission *from* any form of image-producing device *to* any other form of image-producing device.

Further, the present invention provides viable 1D symbology support at the implementation layer, and a specific implementation with the ASIA software. However, with 1D symbology the same number or classification being assigned to

different images is, in a 1D implementation, theoretically possible.

Use of 2D symbology barcoding eliminates the possibility of ambiguity resulting from the same classification or archive identifiers being assigned to the same image and is therefore preferred. The use of 2D symbology together with the classification and archiving scheme of the present invention can protect any granularity of proprietary image data; provide unobtrusive labeling on prints or print description plates; expose archival encoding directly onto media at exposure, processing, and/or development time; and yield rapid data collection through sorting machines for media, such as transparencies, prints, etc. ASIA provides native support of 2D Data Matrix to facilitate such application development.

3D+ (holographic) symbologies will permit tracking greater lineage depths in single symbols. Supporting this 3D implementation requires no additional complexity to the system.

Schemata

This section describes the invention's schemata, characterized through the tables that follow. Tables 6 and 7, provide a guide to the organization of schemata of the present invention. Tables 9-17 describe the conventions, syntax, and semantics of *location numbers*, *image numbers*, and *parent numbers*. Tables 19-26 fully expand the semantics listed in Table 13 entitled "Image semantics."

Table 6 (following) lists all tables that specify the classification scheme of the present invention. In this table, exact table names are identified together with a brief description of each table which describes the contents of that table.

Tables	Description
Table 9 Conventions	Conventions for all tables
Table 10 Syntax	Syntactic summaries
Table 11 Size/res. syntax	"
Table 12 Locations semantics	Semantic summaries
Table 13 Image semantics	"
Table 14 Parent semantics	"
Table 15 Measure semantics	"
Table 15 Software Packages	"
Table 16 Format semantics	"
Table 17 Size examples	Illustrations of *size*
Table 18 Resolution examples	"
Table 19 Reserved media slots	Specifics for Table 13
Table 20 Color transparency film	"
Table 21 Color negative film	"
Table 22 Black & White film	"
Table 23 Duplicating & internegative film	"
Table 24 Facsimile	"
Table 25 Prints	"
Table 26 Digital	"

Table 6: Schemata tables

Similarly, Table 7 (following) entitled **"Table groupings"** further groups the specification table by the categories in which they are discussed in the following pages.

Title	Table No.
Conventions:	Table 9
Syntax:	Tables 10-11
Semantics:	Tables 12-16
Examples:	Tables 17-18
Media:	Tables 19-26

Table 7: Table groupings

Conventions: Table 9

Table 9 entitled **"Conventions"** fully specifies the conventions governing all tabular information in the archival and classification scheme of the present invention. In Table

9, the column **Form** lists the conventions governing syntactic items for all tables in of the present invention. Specific conventions are the following.

- *Emphasized* words indicate variables.
- ROMAN words indicate constant or literal values.
- Angle-brackets <> indicate required material.
- Brackets [] indicate optional material.
- Parentheses () indicate logical groupings.
- Braces {} indicate regular expression modifiers.
- The bar '|' character indicates an alternative.
- The star '*' character indicates "0 or more".
- The plus '+' character indicates "1 or more".

The columns **Variables** comprehensively lists all variables used in Appendix **Schemata**. Each variable represents a single length character, so *n* represents any single digit (not any number of any digit). Specific variables are:

- '*l*' indicates any alphabetical character a-z
- '*n*' indicates any number 0-9
- '*c*' indicates any alphabetical character a-z, or a number 0-9
- '*y*' indicates a digit used to construct the year
- '*m*' indicates a digit used to construct the month
- '*d*' indicates a digit used to construct the day

  '*h*' indicates a digit used to construct the

hour

- '*t*' indicates a digit used to construct the minute
- '*s*' indicates a digit used to construct the second
- '*i*' indicates a digit used to construct a fractional second.

Table 9: Conventions

Form	Description	Variables	Description
emphasis	variable	*l*	letter
ROMAN	constant	*n*	number
< >	required	*c*	class *ln*
[ ]	optional		
( )	grouping	*y*	year
{ }	modifier	*m*	month
|	alteration	*d*	day
*	0 or more	*h*	hour
+	1 or more	*t*	minute
		s	second
		i	fractional second

Syntax: Tables 10-11

Tables 10-11 strictly conform to the syntactic rules of Table 9 **Conventions** (above). Specifics are described according to two logical divisions:

1. **¶Location, image, & parent syntax**. This is described in Table 10 entitled "Syntax." Table 10 Syntax

provides a compact summary of the present invention's functionality.

2. ¶**Size & resolution syntax**. This is described in Table 11 entitled "Size/res. syntax." Table 11 **Size/res. syntax** expands the syntax rules for the variable *size* and *resolution,* introduced in Table 10.

Location, image & parent syntax. In Table 10 **Syntax**, the *rows* assigned to **Location, Image** and **Parent** respectively provide:

1. An example of a number ('Example'), showing small and large illustrations of the schemata.
2. The names of each field used by a number ('Names').
3. The specific syntactic rules governing a number('Syntax').

The *columns* identify the type of number ('#'), category, and row illustration.

The association of a *location number* and *image number* guarantees a unique identification of every image in an archive. The association of a *location number, image number,* and *parent number* guarantees unique identification and fully recoverable patent-child relations.

Location numbers track serial and chronological location. Specific fields are (a) required entries *generation, sequence,* and *date;* and (b) optional entries *time, author, device, unit, locationRes,* and *locationCus.* The required entries guarantee minimal tracking information and data consistency for basic electronic sorting, while the optional entries provide

additional granularity for high volume tracking (there are no theoretical size limitations).

Image numbers track primarily physical attributes of images across devices, media types, and storage conditions. Specific fields are (a) required entries *category size, media, push* **or** *bit, resolution, stain,* and *format*; and (b) optional entries, *imageRes* and *imageCus*. Either *push* or *bit* is always required, but both are never permissible. The *format* field determines whether *push* or *bit* is used: *bit* is used when *format* is digitally related, otherwise *push* is used.

Parent numbers track the date and time of parent conception, and optional data. Specific fields are (a) the required entry *parent*, and (b) optional entries *parentRes* and *parentCus*. The required entry encodes parent information for a given child image, while the optional entries provide specification extension and user customization.

Table 10: Syntax

<table>
<tr><th>#</th><th>Category</th><th>Illustration</th></tr>
<tr><td>Location</td><td>Example:
Names:
Syntax:
:</td><td>small: A1040-199609; large: A1011-19920417T05365699CPG@2-12345:A1.Z2
<<i>generation</i>> <<i>sequence</i>> <<i>date</i>> [<i>time</i>] [<i>author</i>] [<i>device</i>] [<i>unit</i>] [<i>locationRes</i>] [<i>locationCus</i>]
<<i>l</i>{+}> <<i>n</i>{+}> <<i>yyyymm</i>[<i>dd</i>]> [T <i>hhtt</i>[<i>ss</i>[<i>i</i>{+}]]] [<i>l</i>{+}] [@<i>c</i>{+}] [-<i>n</i>{+}] [.<i>c</i>{+}] [:<i>c</i>{+}]</td></tr>
<tr><td>Image</td><td>Example:
Names:
Syntax:
:</td><td>small: S135+1KCAM@0200S:2T; large: S135F-024GIF8@HP@0300DI:6D:1A2B.5E
<<i>category</i>> <<i>size</i>> <[<i>push</i>]> | [<i>bit</i>]> <<i>media</i>> [<i>set</i>] <<i>resolution</i>> <<i>stain</i>> <<i>format</i>> [<i>imageRes</i>] [<i>imageCus</i>]
<<i>l</i>{+}> <<i>nc</i>{*}> <[(- | +) <i>n</i> {+}] | [-<i>n</i>{+}]> <<i>lc</i>{*}> [@ <i>c</i>{+}] @<<i>c</i>{+}> :<<i>n</i>{+}> <<i>a</i>{+}> [: <i>c</i>{+}] [. <i>c</i>{+}]</td></tr>
<tr><td>Parent</td><td>Example:
Names:
Syntax:
:
:</td><td>19961231T235959; large: 19961231T235959999
<<i>parent</i>> <<i>parentRes</i>> <<i>parentCus</i>>
<<i>yyyymm</i>[<i>dd</i>]>[T <i>hhtt</i>[<i>ss</i>[<i>i</i>{+}]]] [: <i>c</i>{+}] [. <i>c</i>{+}]

NB: Second accuracy is minimally recommended for parent-child encoding. Both (a) <i>parent</i> and (b) Location's <i>date</i> and <i>time</i> should use the same specification when possible.</td></tr>
</table>

Size & resolution syntax. Table 11 **Size/res. syntax** specifies syntactic rules governing the variables *size* and *resolution*, previously introduced in Table 10. Table 11 describes how the variables *size* and *resolution* express (a) dimension and (b) units of measure.

The row 'Names' indicates variable names, such as '*<measure>*' for the unit of measure. 'Syntax 1' and 'Syntax 2' are the canonical syntaxes.

Table 11: Size/res. syntax

Category	Illustration			
Names	*<dimension>*			*<measure>*
Syntax 1	*<c{+}>*			*<lc{*}>*
Names	*<X-dimension>*	**X**	*<Y-dimension>*	*<measure>*
Syntax 2	*<n{+}>*	**X**	*<n{+}>*	*<lc{*}>*

NB: Variables *size* and *resolution* use either syntax form. Table 15 **Measure Semantics** lists *measure* values. Table 17 **Size examples** and 18 **Resolution examples** provide illustrations.

Semantics: Tables 12-16

Introduction. Tables 12-16 describe semantic conventions, and fully specify the syntactic rules of Tables 10-11. Values for all variables are *case insensitive*. Tables 12-16 describe the meanings of syntactic names, literal values, descriptions of syntactic elements, and lengths of all fields. Specifics are described according to the following conceptual divisions.

Location semantics	Table 12
Image semantics	Table 13
Parent semantics	Table 14

Measure semantics	Table 15
Format semantics	Table 16

Location semantics. In Table 12 **Location semantics**, **Location** indicates the location number classification. The column **Name** indicates the name of a given location number *field*, while the column **Description,** describes what a *field* means. For example, the field <*date*> within the classification **Location,** describes the date when the lot was made.

In the next column of Table 12, **Syntax,** Table 10's row **Syntax** is relisted in vertical form. The column **Literal** lists the corresponding values or ranges of permissible values. For example, the **Syntax** '-*yyyy*' for the field <*date*> literally expands into a permissible range of 0000-9,999 years. The next column **Description**, describes what the legal value means. For example, '*yyyy*' is the year.

Finally, the column **Length** indicates the permissible length of a given argument. For example, in the <*date*> field, a minimum of 7 characters is required, and a maximum of 9 characters is permissible.

Table 12: Location semantics

Legal Values

#	Name	Description	Syntax	Literal	Description	Length
Location	*<generation>*	Lot generation	*l*{+}	A-Z	A =1st	1+
				AA-ZZ	AA = 27th	
				..	etc.	
	<sequence>	Sequence in archive	*n*{+}	0-9	Lot number	1+
				0000-9999		
				..	etc.	
	<date>	Date made	-*yyyy*	0000-9999	Year	7 [9]
		(ISO 8601:1988	*mm*	01-12	Month	
		compliant)	[*dd*]	01-31	Day	
	[*time*]	Time made	[T *hh*	00-23	Hour	[5+]
		(ISO 8601:1988	*tt*	00-59	Minute	
		compliant, plus	[*ss*	00-59	Second	
		any fractional	[*i*{+}]]]	0-9	Fractional	
		second)			second	
	[*author*]	Author	[*lc*{*}]	a-zA-Z	Author's name	[1+]
				..	etc.	
	[*device*]	Device used	[@*c*{+}]	0-9	Device number	[2+]
				..	etc.	
	[*unit*]	Image in Lot	[-*n*{+}]	0-9	Image number	
				0000-9999		
				..	etc.	[2+]
	[*locationRes*]	Unspecified	[:c{+}]	a-zA-Z0-9	Future use	[2+]
	[*locationCus*]	Unspecified	[.*c*{+}]	a-zA-Z0-9	User Customization	[2+]
					Total	**9 [-25+]**

Imag semantics. In Table 13 **Image semantics**, **Image** indicates the image number classification. The column **Name** indicates the name of a given image number *field*, while the column **Description** describes what a *field* means. For example, the field *<category>* describes the category of the image number.

In the next column of Table 13, **Syntax,** Table 10's row **Syntax** is relisted in vertical form. The next column **Literal**, lists the corresponding values or ranges of permissible values. The next column **Description**, describes what the **Literal** value means. Finally, the column **Length** indicates the permissible length of a given argument. For example, the *<size>* field uses 1 or more characters.

Table 13: Image semantics

<table>
<tr><th></th><th></th><th></th><th></th><th>Legal Values</th><th></th><th></th></tr>
<tr><th>#</th><th>Name</th><th>Description</th><th>Syntax</th><th>Literal</th><th>Description</th><th>Length</th></tr>
<tr><td>Image</td><td><category></td><td>Category</td><td>l{+}</td><td>S</td><td>Single Frame</td><td>1+</td></tr>
<tr><td></td><td></td><td></td><td></td><td>M</td><td>Motion Picture</td><td></td></tr>
<tr><td></td><td><size></td><td>Image or film size</td><td>nc{*}</td><td>(See Table 11</td><td>Size/res. syntax)</td><td>1+</td></tr>
<tr><td></td><td></td><td></td><td></td><td>(See Table 15</td><td>Measure semantics)</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>(See Table 18</td><td>Size examples)</td><td></td></tr>
<tr><td></td><td><i><push</i> |</td><td>Exposure</td><td><(-|+)<i>n</i>{+} |</td><td>0</td><td>No push ('+' = up)</td><td><2+|</td></tr>
<tr><td></td><td></td><td></td><td></td><td>3</td><td>3 stops ('-' = down)</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>..</td><td>etc.</td><td></td></tr>
<tr><td></td><td>bit></td><td>Dynamic range</td><td>-n{+}></td><td>0-9</td><td>E.g. 8=8 bit</td><td>2+></td></tr>
<tr><td></td><td></td><td>("bit depth")</td><td></td><td>..</td><td>etc.</td><td></td></tr>
</table>

#	Name	Description	Syntax	Literal	Description	Length
	<media>	Image media	*lc*{*}	(See Table 20	Reserved)	
				(See Table 21	Slides)	2+
				(See Table 22	Negatives)	
				(See Table 23	B&W)	
				(See Table 24	Dups & Internegs	
				(See Table 25	Facsimiles)	
				(See Table 26	Prints)	
				(See Table 27	Digital)	
	[set]	Package	[@c{+}]	(See Table 17	Packages)	
	<resolution>	Resolution	@*c*{+}	(See Table 11	Size/res. syntax	2+
				(See Table 15	Measure semantics	
				(See Table 19	Resolution examples	
	<stain>	Presentation	:*n*{+}	0	Black & White	1+
		form		1	Gray scale	
				2	Color	
				3	RGB (Red,Grn,Blu)	
				4	YIQ (RGB TV variant)	
				5	CYMK (Cyn,Yel,Mag,BlK)	
				6	HSB (Hue, Sat, Bright)	
		("bit depth")		7	CIE (Commission de l'Eclairage)	
				8	LAB	
					etc.	
	<format>	Image form	*lc*{*}	(See Table 16	Format sematics)	1+

#	Name	Description	Syntax	Literal	Description	Length
	[*imageRes*]	Unspecified	[:*c*{+}]	a-zA-Z0-9	Future use	[2+]
	[*imageCus*]	Unspecified	[.c{+}]	a-zA-Z0-9	User customization	[2+]

Total 10[-16+]

Parent semantics. In Table 14 Parent semantics, **Parent** indicates the parent number classification. The column **Name** indicates the name of a given parent number field, while the column **Description** describes what a given *field* means. For example, the field <*parentRes*> is a reserved field for future use.

In the next column of Table 14, **Syntax,** Table 10's row **Syntax** is relisted in vertical form. The next column **Literal**, lists the corresponding values or ranges of permissible values. The next column **Description**, describes what the **Literal** value means. Finally, the column **Length** indicates the permissible length of a given argument. For example, the <*parent*> field uses 6 or more characters.

Measure semantics. Table 15 **Measure semantics** specifies legal values for the variables *size* and *resolution*, previously described by the rules in Table 11 **Size/res. syntax**.

Table 14: Parent semantics

#	Name	Description	Syntax	Legal Values Literal	Desription	Length
Parent	*<parent>*	Parent	*yyyymm*[*dd*] [T*hhtt*[*ss*[*i*{+}]]]	0-9 0-9T0-9	Date/time	6+
	[*parentRes*]	Unspecified	[:*c*{+}]	a-zA-Z0-9	Future use	[1+]
	[*parentCus*]	Unspecified	[.*c*{+}]	a-zA-Z0-9	User customization	[1+]
						Total
	6 [-8+]					

The column **Category** identifies which values are shared by *size* and *resolution* and which are unique. The column **Literal** lists the abbreviations used in *size* and *resolution* values. The column **Description** expands the abbreviations into their corresponding names.

Table 15: Measure semantics

Category	Literal	Description	
Shared	DI	Dots per inch	(dpi)
	DE	Dots per foot	(dpe)
	DY	Dots per yard	(dpy)
	DC	Dots per centimeter	(dpc)
	DM	Dots per millimeter	(dpm)
	DP	Dots per pixel	(dpp)
	DT	Dots per meter	(dpt)
	M	Millimeters	
	C	Centimeters	
	T	Meters	
	I	Inches	
	E	Feet	
	Y	Yard	
	P	Pixel	
	L	Lines	
	R	Rows	
	O	Columns	
	B	Columns & Rows	
	. .	etc.	
Size Unique	F	Format	
	. .	etc.	
Res. Unique	S	ISO	
	. .	etc.	

Format semantics. Table 16 Format semantics specifies legal values for the variable *format*, previously described in Table 13 Image semantics. The **Literal** column lists legal values and

the **Description** column expands the abbreviations into their corresponding names.

Table 16: Format semantics

Literal	Description
A	Audio-visual
C	Photocopy
D	Digital
F	Facsimile
L	Plotter
M	MRI
N	Negative
P	Print
R	Vector graphics
T	Transparency
V	Video
X	X-radiographic
..	etc.

Table 17: Packages

Literal	Description
3C	3Com
3M	3M
AD	Adobe
AG	AGFA
AIM	AIMS Labs
ALS	Alesis
APP	Apollo
APL	Apple
ARM	Art Media
ARL	Artel
AVM	Aver Media Technologies
ATT	AT&T
BR	Bronica
BOR	Borland
CN	Canon
CAS	Casio
CO	Contax
CR	Corel
DN	Deneba
DL	DeLorme
DI	Diamond
DG	Digital
DIG	Digitech

EP	Epson
FOS	Fostex
FU	Fuji
HAS	Hasselblad
HP	Hewlett Packard
HTI	Hitachi
IL	Iilford
IDX	IDX
IY	Iiyama
JVC	JVC
KDS	KDS
KK	Kodak
KN	Konica
IBM	IBM
ING	Intergraph
LEI	Leica
LEX	Lexmark
LUC	Lucent
LOT	Lotus
MAM	Mamiya
MAC	Mackie
MAG	MAG Innovision
MAT	Matrox Graphics
MET	MetaCreations
MS	Microsoft
MT	Microtech
MK	Microtek
MIN	Minolta
MTS	Mitsubishi
MCX	Micrografx
NEC	NEC
NTS	Netscape
NTK	NewTek
NK	Nikon
NS	Nixdorf-Siemens
OLY	Olympus
OPC	Opcode
OR	O'Reilly
PAN	Panasonic
PNC	Pinnacle
PNX	Pentax
PO	Polaroid
PRC	Princeton Graphics
QT	Quicktime
ROL	Roland
RO	Rollei
RIC	Ricoh
SAM	Samsung
SAN	SANYO
SHA	Sharp
SHI	Shin Ho
SK	Softkey
SN	Sony
SUN	SUN
TAS	Tascam
TEAC	TEAC

TKX	Tektronix
TOS	Toshiba
ULS	Ulead systems
UMX	UMAX
VWS	ViewSonic
VID	Videonics
WG	Wang
XX	Unknown
XE	Xerox
YAS	Yashica
YAM	Yamaha

Table 18: Size examples

Literal	Dimension		Measure
Syntax 1	135F	35mm	format
	120F	Medium	format
	220F	Full	format
	4X5F	4x5	format
	..	..	etc.
Syntax 2	9X14C	9x14	centimeter
	3X5I	3x5	inch
	4X6I	4x6	inch
	5X7I	5x7	inch
	8X10I	8x10	inch
	11X14I	11x14	inch
	16X20I	16x20	inch
	20X24I	20x24	inch
	24X32I	24x32	inch
	24X36I	24x36	inch
	32X40I	32x40	inch
	40X50I	40x50	inch
	50X50I	50x50	inch
	40X50P	40X50	pixels
	100X238P	100X238	pixels
	1024X1280P	1024X1280	pixels
	A4S	210x297mm	sheet
	A5S	148x210mm	sheet
	JIS B5S	182x257mm	sheet
	LETTERS	8.5x11in	sheet
	LEGALS	8.5x14in	sheet
	EXECUTIVES	7.25x10.5in	sheet
	..	..	etc.

Examples: Tables 18-19

Size & resolution examples. Table 18 **Size examples** illustrates typical *size* values, and Table 19 **Resolution examples** illustrates typical *resolution* values.

Values in these tables represent limited defaults since

size and *resolution* are algorithmically generated from the rules contained in Table 11 **Size/r s. syntax**, and from the values contained in Table 15 **Measure semantics**. See ¶**Size & resolution syntax** for details.

Table 19: Resolution examples

Literal	Dimension	Measure	
Syntax 1	50S	50	ISO
	200S	200	ISO
	300DC	600	dpc
	1200DI	1200	dpi
	..	..	etc.
Syntax 2	640X768P	640X768	pixels
	1024X1280P	1024X1280	pixels
	1280X1600P	1024X1280	pixels
	..	..	etc.

Media: Tables 20-27

Table 20-27 specify the supported *media* listed in Table 13 **Image semantics**. Values of *media* are tied to values of *format*, so any *format* value may have its own *media* table. Since *format* is unlimited in size, *media* support is also unlimited.

Tables 20-24: Film Media. In Tables 20-24, the first character represents film manufacturers in the following ways:

- 'A' represents Agfa
- 'F' represents Fuji
- 'I' represents Ilford
- 'C' represents Konica
- 'K' represents Kodak
- 'P' represents Polaroid

- 'S' represents Seattle Film Works
- 'T' represents 3M
- 'X' represents an unknown film manufacturer

This leaves 17 slots for additional major film manufacturers, before a single first letter prefix must represent multiple manufacturers, or before additional letters must be added.

Any number of film media may be supported, but 223 defaults are provided in the preferred embodiment of the present invention.

Table 20: Reserved media slots

Reserved For	Literal	Description
Unknown	XXXX	Unknown film
User	UX0	Customization
	UX1	"
	UX2	"
	UX3	"
	UX4	"
	UX5	"
	UX6	"
	UX7	"
	UX8	"
	UX9	"
Specification	UR0	For future use
	UR1	"
	UR2	"
	UR3	"
	UR4	"
	UR5	"
	UR6	"
	UR7	"
	UR8	"
	UR9	"

Table 21: Color Transparency film

Company	Literal	Description
Agfa	AASC	Agfa Agfapan Scala Reversal (B&W)
	ACRS	Agfa Agfachrome RS
	ACTX	Agfa Agfachrome CTX
	ARSX	Agfa Agfacolor Professional RSX Reversal
Fuji	FCRTP	Fuji Fujichrome RTP
	FCSE	Fuji Fujichrome Sensia
	FRAP	Fuji Fujichrome Astia
	FRDP	Fuji Fujichrome Provia Professional 100
	FRPH	Fuji Fujichrome Provia Professional 400
	FRSP	Fuji Fujichrome Provia Professional 1600
	FRTP	Fuji Fujichrome Professional Tungsten
	FRVP	Fuji Fujichrome Velvia Professional
Ilford	IICC	Ilford Ilfochrome
	IICD	Ilford Ilfochrome Display
	IICM	Ilford Ilfochrome Micrographic
Konica	CAPS	Konica APS JX
	CCSP	Konica Color Super SR Professional
Kodak	K5302	Kodak Eastman Fine Grain Release Positive Film 5302
	K7302	Kodak Fine Grain Positive Film 7302
	KA2443	Kodak Aerochrome Infrared Film 2443
	KA2448	Kodak Aerochrome II MS Film 2448
	KE100SW	Kodak Ektachrome Professional E100SW Film

	KE100S	Kodak Ektachrome Professional E100S Film
	KE200	Kodak Ektachrome Professional E200 Film
	KEEE	Kodak Ektachrome Elite
	KEEO100	Kodak Ektachrome Electronic Output Film 100
	KEEO200	Kodak Ektachrome Electronic Output Film
	KEEO64T	Kodak Ektachrome Electronic Output Film 64T
	KEEP	Kodak Ektachrome E Professional
	KEES	Kodak Ektachrome ES
	KEEW	Kodak Ektachrome EW
	KEIR	Kodak Ektachrome Professional Infrared EIR Film
	KEK	Kodak Ektachrome
	KELL	Kodak Ektachrome Lumiere Professional
	KELX	Kodak Ektachrome Lumiere X Professional
	KEPD	Kodak Ektachrome 200 Professional Film
	KEPF	Kodak Ektachrome Professional
	KEPH	Kodak Ektachrome Professional P1600 Film
	KEPJ	Kodak Ektachrome 320T Professional Film, Tungsten
	KEPL400	Kodak Ektachrome Professional 400X Film
	KEPL	Kodak Ektachrome 200 Professional Film
	KEPL	Kodak Ektachrome Plus Professional
	KEPN	Kodak Ektachrome 100 Professional Film
	KEPO	Kodak Ektachrome P Professional
	KEPR	Kodak Ektachrome 64 Professional
	KEPT	Kodak Ektachrome 160T Professional Film, Tungsten
	KEPY	Kodak Ektachrome 64T Professional Film, Tungsten
	KETP	Kodak Ektachrome T Professional
	KETT	Kodak Ektachrome T
	KEXP	Kodak Ektachrome X Professional
	KCCR	Kodak Kodachrome
	KPKA	Kodak Kodachrome Professional 64 Film
	KPKL	Kodak Kodachrome Professional 200 Film
	KPKM	Kodak Kodachrome Professional 25
	KVSSO279	Kodak Film Vericolor Slide Film SO-279
	KVS	Kodak Vericolor Slide Film
Polaroid	PPCP	Polaroid Professional High Contrast Polychrome
Reserved	--	See Table 20
Seattle Film Works	SFWS	Seattle Film Works
3M	TSCS	3M ScotchColor Slide
	TSCT	3M ScotchColor T slide

Table 22: Color negative film

Company	Literal	Description
Agfa	ACOP	Agfa Agfacolor Optima
	AHDC	Agfa Agfacolor HDC
	APOT	Agfa Agfacolor Triade Optima Professional
	APO	Agfa Agfacolor Professional Optima
	APP	Agfa Agfacolor Professional Portraita
	APU	Agfa Agfacolor Professional Ultra
	APXPS	Agfa Agfacolor Professional Portrait XPS
	ATPT	Agfa Agfacolor Triade Portraita Professional
	ATUT	Agfa Agfacolor Triade Ultra Professional
Fuji	FHGP	Fuji Fujicolor HG Professional

	FHG	Fuji Fujicolor HG
	FNHG	Fuji Fujicolor NHG Professional
	FNPH	Fuji Fujicolor NPH Professional
	FNPL	Fuji Fujicolor NPL Professional
	FNPS	Fuji Fujicolor NPS Professional
	FPI	Fuji Fujicolor Print
	FPL	Fuji Fujicolor Professional, Type L
	FPO	Fuji Fujicolor Positive
	FRG	Fuji Fujicolor Reala G
	FR	Fujicolor Reala
	FSGP	Fuji Fujicolor Super G Plus
	FSG	Fuji Fujicolor Super G
	FSHG	Fuji Fujicolor Super HG 1600
	FS	Fuji Fujicolor Super
Kodak	K5079	Kodak Motion Picture 5079
	K5090	Kodak CF1000 5090
	K5093	Kodak Motion Picture 5093
	K5094	Kodak Motion Picture 5094
	KA2445	Kodak Aerocolor II Negative Film 2445
	KAPB	Advantix Professional Film
	KCPT	Kodak Kodacolor Print
	KEKA	Kodak Ektar Amateur
	KEPG	Ektapress Gold
	KEPPR	Kodak Ektapress Plus Professional
	KGOP	Kodak Gold Plus
	KGO	Kodak Gold
	KGPX	Kodak Ektacolor Professional GPX
	KGTX	Kodak Ektacolor Professional GTX
	KPCN	Kodak Professional 400 PCN Film
	KPHR	Kodak Ektar Professional Film
	KPJAM	Kodak Ektapress Multispeed
	KPJA	Kodak Ektapress 100
	KPJC	Kodak Ektapress Plus 1600 Profession
	KPMC	Kodak Pro 400 MC Film
	KPMZ	Kodak Pro 1000 Film
	KPPF	Kodak Pro 400 Film
	KPRMC	Kodak Pro MC
	KPRN	Kodak Pro
	KPRT	Kodak Pro T
	KRGD	Kodak Royal Gold
	KVPS2L	Kodak Vericolor II Professional Type L
	KVPS3S	Kodak Vericolor III Professional Type S
	KVP	Kodak Vericolor Print Film
Konica	CCIP	Konica Color Impresa Professional
	CIFR	Konica Infrared 750
	CCSR	Konica SRG
Polaroid	POCP	Polaroid OneFilm Color Print
Reserved	--	See Table 20

Table 23: Black & white film

Company	Literal	Description
Agfa	AAOR	Agfa Agfapan Ortho
	AAPX	Agfa Agfapan APX
	APAN	Agfa Agfapan
Ilford	IDEL	Ilford Delta Professional
	IFP4	Ilford FP4 Pl
	IHP5	Ilford HP5 Plus
	IPFP	Ilford PanF Plus
	IPSF	Ilford SFX750 Infrared
	IUNI	Ilford Universal
	IXPP	Ilford XP2 Plus
Fuji	FNPN	Fuji Neopan
Kodak	K2147T	Kodak PLUS-X Pan Professional 2147, ESTAR Thick Base
	K2147	Kodak PLUS-X Pan Professional 2147, ESTAR Base
	K4154	Kodak Contrast Process Ortho Film 4154, ESTAR Thick Base
	K4570	Kodak Pan Masking Film 4570, ESTAR Thick Base
	K5063	Kodak TRI-X 5063
	KA2405	Kodak Double-X Aerographic Film 2405
	KAI2424	Kodak Infrared Aerographic Film 2424
	KAP2402	Kodak PLUS-X Aerographic II Film 2402, ESTAR Base
	KAP2412	Kodak Panatomic-X Aerographic II Film 2412, ESTAR Base
	KEHC	Kodak Ektagraphic HC
	KEKP	Kodak Ektapan
	KH13101	Kodak High Speed Holographic Plate, Type 131-01
	KH13102	Kodak High Speed Holographic Plate, Type 131-02
	KHSIET	Kodak High Speed Infrared, ESTAR Thick Base
	KHSIE	Kodak High Speedo nfrared, ESTAR Base
	KHSI	Kodak High Speed Infrared
	KHSO253	Kodak High Speed Holographic Film, ESTAR Base SO-253
	KLPD4	Kodak Professional Precision Line Film LPD4
	KO2556	Kodak Professional Kodalith Ortho Film 2556
	KO6556	Kodak Professional Kodalith Ortho Film 6556, Type 3
	KPMF3	Kodak Professional Personal Monitoring Film, Type 3
	KPNMFA	Kodak Professional Personal Neutron Monitor Film, Type A
	KPXE	Kodak PLUS-X Pan Professional, Retouching Surface, Emulsion & Base
	KPXP	Kodak PLUS-X Pan Professional, Retouching Surface, Emulsion
	KPXT	Kodak PLUS-X Pan Professional, Retouching Surface, Emulsion & Base
	KPXX	Kodak Plus-X
	KPX	Kodak PLUS-X Pan Film
	KREC	Kodak Recording 2475
	KSAF1	Kodak Spectrum Analysis Film, No. 1
	KSAP1	Kodak Spectrum Analysis Plate, No. 1
	KSAP3	Kodak Spectrum Analysis Plate, No. 3
	KSWRP	Kodak Short Wave Radiation Plate
	KTMXCN	Kodak Professional T-MAX Black and White Film CN
	KTMY	Kodak Professional T-MAX
	KTMZ	Kodak Professional T-MAX P3200 Film
	KTP2415	Kodak Technical Pan Film 2415, ESTAR-AH Base
	KTPKTRP	KodakKTechnicaloPandFilmak TRI-Pan Professional
	KTRXPT	Kodak TRI-X Pan Professional 4164, ESTAR Thick Base
	KTRXP	Kodak TRI-Pan Professional

	KTXP	Kodak TRI-X Professional, Interior Tungsten
	KTXT	Kodak TRI-X Professional, Interior Tungsten
	KTX	Kodak TRI-X Professional
	KVCP	Kodak Verichrome Pan
Konica	CIFR	Kodak Infrared 750
Polaroid	PPGH	Konica Polagraph HC
	PPLB	Polaroid Polablue BN
	PPPN	Polaroid Polapan CT
Reserved	--	See Table 20

Table 24: Duplicating & Internegative Film

Company	Literal	Description
Agfa	ACRD	Agfa Agfachrome Duplication Film CRD
Fuji	FCDU	Fuji Fujichrome CDU Duplicating
	FCDU1	Fujichrome CDU Duplicating, Type I
	FCDU2	Fuji Fujichrome CDU Duplicating, Type II
	FITN	Fuji Fujicolor Internegative IT-N
Kodak	K1571	Kodak 1571 Internegative
	K2475RE	Kodak Recording Film 2475
	K4111	Kodak 4111
	KC4125	Kodak Professional Professional Copy Film 4125
	K6121	Kodak 6121
	KA2405	Kodak Double-X Aerographic Film 2405
	KA2422	Kodak Aerographic Direct Duplicating Film 2422
	KA2447	Kodak Aerochrome II Duplicating Film 2447
	KAR	Kodak Aerographic RA Duplicating Film 2425, ESTAR Base
	KARA4425	Kodak Aerographic RA Duplicating Film 4425, ESTAR Thick Base
	KARA	Kodak Aerographic RA Duplicating Film
	KCIN	Kodak Commercial Internegative Film
	KE5071	Kodak Ektachrome Slide Duplicating Film 5071
	KE5072	Kodak Ektachrome Slide Duplicating Film 5072
	KE6121	Kodak Ektachrome Slide Duplicating Film 6121
	KE7121K	Kodak Ektachrome Duplicating Film 7121, Type K
	KESO366	Kodak Ektachrome SE Duplicating Film SO -366
	KS0279	Kodak S0279
	KS0366	Kodak S0366
	KSO132	Kodak Professional B/W Duplicating Film SO-132
	KV4325	Kodak Vericolor Internegative 4325
	KVIN	Kodak Vericolor Internegative Film
Reserved	--	See Table 20

Table 24: Facsimile. Table 24 **Facsimile** lists supported file formats used in facsimile imaging. All digital formats are supported, plus G1-G5, for a total of 159 supported formats. Any number of facsimile media are permissible.

Table 25: Facsimile

Category	Literal	Description
Digital	--	See Table 27
Facsimile	DFAXH	DigiBoard, DigiFAX Format, Hi-Res
	DFAXL	DigiBoard, DigiFAX Format, Normal-Res
	G1	Group 1 Facsimile
	G2	Group 2 Facsimile
	G3	Group 3 Facsimile
	G32D	Group 3 Facsimile, 2D
	G4	Group 4 Facsimile
	G42D	Group 4 Facsimile, 2D
	G5	Group 4 Facsimile
	G52D	Group 4 Facsimile, 2D
	TIFFG3	TIFF Group 3 Facsimile
	TIFFG3C	TIFF Group 3 Facsimile, CCITT RLE 1D
	TIFFG32D	TIFF Group 3 Facsimile, 2D
	TIFFG4	TIFF Group 4 Facsimile
	TIFFG42D	TIFF Group 4 Facsimile, 2D
	TIFFG5	TIFF Group 5 Facsimile
	TIFFG52D	TIFF Group 5 Facsimile, 2D
Reserved	--	See Table 20

Table 26: Prints. Table 26 **Prints** lists supported file formats used in print imaging, such as paper prints for display. 230 defaults are provided; any number of print media are permissible.

Table 26: Prints

Company	Literal	Description
Agfa	ACR	Agfacolor RC
	ABF	Agfa Brovira, fiber, B&W
	ABSRC	Agfa Brovira-speed RC, B&W
	APF	Agfa Portriga, fiber, B&W
	APSRC	Agfa Portriga-speed RC, B&W
	ARRF	Agfa Record-rapid, fiber, B&W
	ACHD	Agfacolor HDC
	AMCC111FB	Agfacolor Multicontrast Classic MC C 111 FB, double weight, glossy surface
	AMCC118FB	Agfacolor Multicontrast Classic MC C 118 FB, double weight, fine grained matt surface
	AMCC1FB	Agfacolor Multicontrast Classic MC C 1FB, single weight, glossy surface

	AMCP310RC	Agfacolor Multicontrast Premium RC 310, glossy surface
	AMCP312RC	Agfacolor Multicontrast Premium RC 312, semi-matt surface
	APORG	Agfacolor Professional Portrait Paper, glossy surface CN310
	APORL	Agfacolor Professional Portrait Paper, semi-matt surface CN312
	APORM	Agfacolor Professional Portrait Paper, lustre surface CN319
	ASIGG	Agfacolor Professional Signum Paper, glossy surface CN310
	ASIGM	Agfacolor Professional Signum Paper, matt surface CN312
Konica	CCOL	Konica Color
Fuji	FCHPFCPI	FujicolorFHGuProfessionaljicolor Print
	FCSP	Fujicolor Super G Plus Print
	FCT35	Fujichrome paper, Type 35, glossy surface
	FCT35HG	Fujichrome reversal copy paper, Type 35, glossy surface
	FCT35HL	Fujichrome reversal copy paper, Type 35, lustre surface
	FCT35HM	Fujichrome reversal copy paper, Type 35, matt surface
	FCT35L	Fujichrome paper, Type 35, lustre surface
	FCT35M	Fujichrome paper, Type 35, matt surface
	FCT35PG	Fujichrome Type535, polyester, super glossly surface
	FSFA5G	Fujicolor paper super FA, Type 5, glossy SFA5 surface
	FSFA5L	Fujicolor paper super FA, Type 5, lustre SFA5 surface
	FSFA5M	Fujicolor paper super FA, Type 5, matt SFA5 surface
	FSFASCG	Fujicolor.paper super FA5, Type C, glossy surface
	FSFA5SL	Fujicolor paper super FA5, Type C, lustre surface
	FSFA5SM	Fujicolor paper super FA5, Type C, matt surface
	FSFA5SPG	Fujicolor paper super FA, Type 5P, glossy SFA P surface
	FSFA5SPL	Fujicolor paper super FA, Type 5P, lustre SFA P surface
	FSFA5SPM	Fujicolor paper super FA, Type 5P, matt SFA P surface
	FSFAG	Fujicolor paper super FA, Type 5, glossy surface
	FSFAL	Fujicolor paper super FA, Type 5, lustre surface
	FSFAM	Fujicolor paper super FA, Type 5, matt surface
	FSFAS5PG	Fujicolor paper super FA, Type P, glossy SFA 5P surface
	FSFAS5PL	Fujicolor paper super FA, Type P, lustre SFA 5P surface
	FSFAS5PM	Fujicolor paper super FA, Type P, matt SFA 5P surface
	FSFASCG	Fujicolor paper super FA, Type C, glossy surface
	FSFASCL	Fujicolor paper super FA, Type C, lustre surface
	FSFASCM	Fujicolor paper super FA, Type C, matt surface
	FTRSFA	Fujitrans super FA
	FXSFA	Fujiflex super FA polyester (super gloss), Fujiflex SFA surface
Ilford	ICF1K	Ilfochrome Classic Deluxe Glossy Low Contrast
	ICLM1K	Ilfochrome Classic Deluxe Glossy Medium Contrast
	ICPM1M	Ilfochrome Classic RC Glossy
	ICPM44M	Ilfochrome Classic RC Pearl
	ICPS1K	Ilfochrome Classic Deluxe Glossy
	IGFB	Ilfochrome Galerie FB
	IILRA1K	Ilfocolor Deluxe
	IIPRAM	Ilfocolor RC
	IMG1FDW	Ilford Multigrade Fiber, Double Weight
	IMG1FW	Ilford Multigrade Fiber Warmtone
	IMG1RCDLX	Ilford Multigrade RC DLX

	IMG1RCPDW	Ilford Multigrade RC Portfolio, Double Weight
	IMG1RCR	Ilford Multigrade RC Rapid
	IMG2FDW	Ilford Multigrade II Fiber, Double Weight
	IMG2FW	Ilford Multigrade II Fiber Warmtone
	IMG2RCDLX	Ilford Multigrade II RC
	IMG1RCPDW	Ilford Multigrade II RC Portfolio, Double Weight
	IMG2RCR	Ilford Multigrade II RC Rapid
	IMG3FDW	Ilford Multigrade III Fiber, Double Weight
	IMG3FW	Ilford Multigrade III Fiber Warmtone
	IMG3RCDLX	Ilford Multigrade III RC DLX
	IMG3RCPDW	Ilford Multigrade III RC Portfolio, Double Weight
	IMG3RCR	Ilford Multigrade III RC Rapid
	IMG4FDW	Ilford Multigrade IV Fiber, Double Weight
	IMG4FW	Ilford Multigrade IV Fiber Warmtone
	IMG4RCDLX	Ilford Multigrade IV RC DLX
	IMG4RCPDW	Ilford Multigrade IV RC Portfolio, Double Weight
	IMGFSWG	Ilford Multigrade Fiber, Single Weight, glossy
	IPFP	Ilford PanF Plus
	ISRCD	Ilfospeed RC, Deluxe
Kodak		B&W Selective Contrast Papers
	KPC1RCE	Kodak Polycontrast RC, medium weight, fine-grained, lustre
	KPC1RCF	Kodak Polycontrast RC, medium weight, smooth, glossy
	KPC1RCN	Kodak Polycontrast RC, medium weight, smooth, semi-matt
	KPC2RCE	Kodak Polycontrast II RC, medium weight, fine-grained, lustre
	KPC2RCF	Kodak Polycontrast II RC, medium weight, smooth, glossy
	KPC2RCN	Kodak Polycontrast II RC, medium weight, smooth, semi-matt
	KPCRCE	Kodak Polycontrast III RC, medium weight, fine-grained, lustre
	KPC3RCF	Kodak Polycontrast III RC, medium weight, smooth, glossy
	KPC3RCN	Kodak Polycontrast III RC, medium weight, smooth, semi-matt
	KPMFF	Kodak Polymax Fiber, single weight, smooth, glossy
	KPMFN	Kodak Polymax Fiber, single weight, smooth, semi-matt
	KPMFE	Kodak Polymax Fiber, single weight, fine-grained, lustre
	KPM1RCF	Kodak Polymax RC, single weight, smooth, glossy
	KPM1RCE	Kodak Polymax RC, single weight, fine-grained, lustre
	KPM1RCN	Kodak Polymax RC, single weight, smooth, semi-matt
	KPM2RCF	Kodak Polymax II RC, single weight, smooth, glossy
	KPM2RCE	Kodak Polymax II RC, single weight, fine-grained, lustre
	KPM2RCN	Kodak Polymax II RC, single weight, smooth, semi-matt
	KPMFAF	Kodak Polymax Fine-Art, double weight, smooth, glossy
	KPMFAN	Kodak Polymax Fine-Art, double weight, smooth, semi-matt
	KPPFM	Kodak Polyprint RC, medium weight, smooth, glossy
	KPPNM	Kodak Polyprint RC, medium weight, smooth, semi-matt
	KPPEM	Kodak Polyprint RC, medium weight, fine-grained, lustre
	KPFFS	Kodak Polyfiber, single weight, smooth, glossy
	KPFND	Kodak Polyfiber, double weight, smooth, semi-matt
	KPFGL	Kodak Polyfiber, light weight, smooth,lustre
	KPFNS	Kodak Polyfiber, smooth, single weight, semi-matt
	KPFND	Kodak Polyfiber, double weight, smooth, semi-matt

KPFGD	Kodak Polyfiber, double weight, fine-grained, lustre
	B&W Continuous Tone Papers
KAZOF	Kodak AZO, fine-grained, lustre
KB1RCF	Kodak Kodabrome RC Paper, smooth, glossy
KB1RCG1	Kodak Kodabrome RC, premium weight (extra heavy) 1, fine-grained, lustre
KB1RCN	Kodak_Kodabrome_RC_Paper,_smooth,_semi-matt
KB2RCF	Kodak Kodabrome II RC Paper, smooth, glossy
KB2RCG1	Kodak Kodabrome II RC, premium weight (extra heavy) 1, fine-grained, lustre
KB2RCN	Kodak Kodabrome II RC Paper, smooth, semi-matt
KBR	Kodak Kodabromide, single weight, smooth, glossy
KEKLG	Kodak Ektalure, double weight, fine-grained, lustre
KEKMSCF	Kodak Ektamatic SC single weight, smooth, glossy
KEKMSCN	Kodak Ektamatic SC, single weight, smooth, semi-matt
KEKMXRALF	Kodak Ektamax RA Professional L, smooth, glossy
KEKMXRALN	Kodak Ektamax RA Professional L, smooth, semi-matt
KEKMXRAMF	Kodak Ektamax RA Professional M, smooth, glossy
KEKMXRAMN	Kodak Ektamax RA Professional M, smooth, smooth, semi-matt
KELFA1	Kodak Elite Fine-Art, premium weight (extra heavy) 1, ultra-smooth, high-lustre
KELFA2	Kodak Elite Fine-Art, premium weight (xtra heavy) 2, ultra-smooth, high-lustre
KELFA3	Kodak Elite Fine-Art, premium weight (xtra heavy) 3, ultra-smooth, high-lustre
KELFA4	Kodak Elite Fine-Art, premium weight (xtra heavy) 4, ultra-smooth, high-lustre
KK1RCG1	Kodak Kodabrome RC, premium weight (extra heavy) 1, fine-grained, lustre
KK1RCG2	Kodak Kodabrome RC, premium weight (extra heavy) 2, fine-grained, lustre
KK1RCG3	Kodak Kodabrome RC, premium weight (extra heavy) 3, fine-grained, lustre
KK1RCG4	Kodak Kodabrome RC, premium weight (extra heavy) 4, fine-grained, lustre
KK1RCG5	Kodak Kodabrome RC, premium weight (extra heavy) 5, fine-grained, lustre
KK2RCG1	Kodak Kodabrome II RC, premium weight (extra heavy) 1, fine-grained, lustre
KK2RCG2	Kodak Kodabrome II RC, premium weight (extra heavy) 2, fine-grained, lustre
KK2RCG3	Kodak Kodabrome II RC, premium weight (extra heavy) 3, fine-grained, lustre
KK2RCG4	Kodak Kodabrome II RC, premium weight (extra heavy) 4, fine-grained, lustre
KK2RCG5	Kodak Kodabrome II RC, premium weight (extra

	heavy) 5, fine-grained, lustre
KPMARCW1	Kodak P-Max Art RC, double weight 1, suede double-matt
KPMARCW2	Kodak P-Max Art RC, double weight 2, suede double-matt
KPMARCW3	Kodak P-Max Art RC, double weight 3, suede double-matt
	B&W Panchromatic Papers
KPSRCH	Kodak Panalure Select RC, H grade, medium weight, smooth, glossy
KPSRCL	Kodak Panalure Select RC, L grade, medium weight, smooth, glossy
KPSRCM	Kodak Panalure Select RC, M grade, medium weight, smooth, glossy
	Color Reversal Papers
KER1F	Kodak Ektachrome Radiance Paper, smooth, glossy
KER1N	Kodak Ektachrome Radiance Paper, smooth, semi-matt
KER1SF	Kodak Ektachrome Radiance Select Material, smooth, glossy
KER2F	Kodak Ektachrome Radiance II Paper, smooth, glossy
KER2N	Kodak Ektachrome Radiance II Paper, smooth, semi-matt
KER2SF	Kodak Ektachrome Radiance II Select Material, smooth, glossy
KER3F	Kodak Ektachrome Radiance III Paper, smooth, glossy
KER3N	Kodak Ektachrome Radiance III Paper, smooth, semi-matt
KER3SF	Kodak Ektachrome Radiance III Select Material, smooth, glossy
KERCHCF	Kodak Ektachrome Radiance HC Copy Paper, smooth, glossy
KERCHCN	Kodak Ektachrome Radiance HC Copy Paper, smooth, semi-matt
KERCN	Kodak Ektachrome Radiance Copy Paper, smooth, semi-matt
KERCTF	Kodak Ektachrome Radiance Thin Copy Paper, smooth, glossy
KERCTN	Kodak Ektachrome Radiance Thin Copy Paper, smooth, semi-matt
KEROM	Kodak Ektachrome Radiance Overhead Material, transparent ESTAR Thick Base
	Color Negative Papers & Transparency Materials
KD2976E	Kodak Digital Paper, Type 2976, fine-grained, lustre
KD2976F	Kodak Digital Paper, Type 2976, smooth, glossy
KD2976N	Kodak Digital Paper, Type 2976, smooth, semi-matt
KDCRA	Kodak Duraclear RA Display Material, clear

KDFRAF	Kodak Duraflex RA Print Material, smooth, glossy
KDT2	Kodak Duratrans Display Material, translucent
KDTRA	Kodak Duratrans RA Display Material, translucent
KECC	Kodak Ektacolor, Type C
KECE	Kodak Ektacolor Professional Paper, fine-graned, lustre
KECF	Kodak Ektacolor Professional Paper, smooth, glossy
KECN	Kodak Ektacolor Professional Paper, smooth, semi-matt
KEC	Kodak Ektacolor
KEP2E	Kodak Ektacolor Portra II Paper, Type 2839, fine-grained, lustre
KEP2F	Kodak Ektacolor Portra II Paper, Type 2839, smooth, glossy
KEP2N	Kodak Ektacolor Portra II Paper, Type 2839, smooth, semi-matt
KEP3E	Kodak Ektacolor Portra III Paper, fine-grained, lustre
KEP3F	Kodak Ektacolor Portra III Paper, smooth, glossy
KEP3N	Kodak Ektacolor Portra III Paper, smooth, semi-matt
KES2E	Kodak Ektacolor Supra II Paper, fine-grained, lustre
KES2F	Kodak Ektacolor Supra II Paper, smooth, glossy
KES2N	Kodak Ektacolor Supra II Paper, smooth, semi-matt
KES3E	Kodak Ektacolor Supra III Paper, fine-grained, lustre
KES3F	Kodak Ektacolor Supra III Paper, smooth, glossy
KES3N	Kodak Ektacolor Supra III Paper, smooth, semi-matt
KESE	Kodak Ektacolor Supra Paper, fine-grained, lustre
KESF	Kodak Ektacolor Supra Paper, smooth, glossy
KESN	Kodak Ektacolor Supra Paper, smooth, semi-matt
KET1	Kodak Ektatrans RA Display Material, smooth, semi-matt
KEU2E	Kodak Ektacolor Ultra II Paper, fine-grained, lustre
KEU2F	Kodak Ektacolor Ultra II Paper, smooth, glossy
KEU2N	Kodak Ektacolor Ultra II Paper, smooth, semi-matt
KEU3E	Kodak Ektacolor Ultra III Paper, fine-grained, lustre
KEU3F	Kodak Ektacolor Ultra III Paper, smooth, glossy
KEU3N	Kodak Ektacolor Ultra III Paper, smooth, semi-matt
KEUE	Kodak Ektacolor Ultra Paper, fine-grained, lustre
KEUF	Kodak Ektacolor Ultra Paper, smooth, glossy
KEUN	Kodak Ektacolor Ultra Paper, smooth, semi-matt
	Inkjet Papers & Films
KEJFC50HG	Kodak Ektajet 50 Clear Film LW4, Polyester Base, clear
KEJFLFSG	Kodak Ektajet Film, Type LF, semi-gloss
KEJFW50HG	Kodak Ektajet 50 White Film, Polyester Base, high gloss
KEJP50SG	Kodak Ektajet 50 Paper, RC Base, semi-gloss
KEJPC	Kodak Ektajet Coated Paper
KEJPCHW	Kodak Ektajet Heavy Weight Coated Paper
KEJPEFSG	Kodak Ektajet Paper, Type EF, semi-gloss

	KEJPLFSG	Kodak Ektajet Paper, Type LF, semi-gloss
Polaroid	POCP	Polaroid OneFilm Color Print
	PPCP	Polaroid Professional High Contrast Polychrome
	PPGH	Polaroid Polygraph HC
	PPLB	Polaroid Polablue BN
	PPPN	Polapan CT
Reserved	--	See Table 20

Table 26: Digital Formats. Table 26 **Digital** lists supported file formats used in digital imaging. 159 default values are provided in the preferred embodiment although any number of digital media are permissible.

Table 27: Digital

Category	Literal	Description
Digital	ACAD	AutoCAD database or slide
	ASCI	ASCII graphics
	ATK	Andrew Toolkit raster object
	AVI	Microsoft video
	AVS	AVS X image
	BIO	Biorad confocal file
	BMP	Microsoft Windows bitmap image
	BMPM	Microsoft Windows bitmap image, monochrome
	BPGM	Bentleyized Portable Graymap Format
	BRUS	Doodle brush file
	CGM	CGM
	CDR	Corel Draw
	CIF	CIF file format for VLSI
	CGOG	Compressed GraphOn graphics
	CMUW	CMU window manager bitmap
	CMX	Corel Vector
	CMYK	Raw cyan, magenta, yellow, and black bytes
	CQT	Cinepak Quicktime
	DVI	Typesetter DeVice Independent format
	EPS	Adobe Encapsulated PostScript
	EPSF	Adobe Encapsulated PostScript file format
	EPSI	Adobe Encapsulated PostScript Interchange format

FIG	Xfig image format
FIT	Flexible Image Transport System
FLC	FLC movie file
FLI	FLI movie file
FST	Usenix FaceSaver(tm) file
G10X	Gemini 10X printer graphics
GEM	GEM image file
GIF	CompuServe Graphics image
GIF8	CompuServe Graphics image (version 87a)
GOUL	Gould scanner file
GRA	Raw gray bytes
HDF	Hierarchical Data Format
HIPS	HIPSIfile
HIS	Image Histogram
HPLJ	Hewlett Packard LaserJet format
HPPJ	Hewlett Packard PaintJet
HTM	Hypertext Markup Language
HTM2	Hypertext Markup Language, level 2
HTM3	Hypertext Markup Language, level 3
HTM4	Hypertext Markup Language, level 4
ICON	Sun icon
ICR	NCSA Telnet Interactive Color Raster graphic format
IFF	Electronic Arts
ILBM	Amiga ILBM file
IMG	Img-whatnot file
JBG	Joint Bi-level image experts Group file interchange format
JPG	Joint Photographic experts Group file interchange format
LISP	Lisp machine bitmap file
MACP	Apple MacPaint file
MAP	Colormap intensities and indices
MAT	Raw matt bytes
MCI	MCI format
MGR	MGR bitmap
MID	MID format
MIF	ImageMagick format
MITS	Mitsubishi S340-10 Color sublimation
MMM	MMM movie file
MOV	Movie format
MP2	Motion Picture Experts Group (MPEG) interchange format, level 2
MP3	Motion Picture Experts Group (MPEG) interchange format, level 3
MPG	Motion Picture Experts Group (MPEG) interchange format, level 1
MSP	Microsoft Paint
MTV	MTV ray tracer image
NKN	Nikon format
NUL	NULL image
PBM	Portable BitMap
PCD	Kodak Photo-CD

PCX	Zsoft IBM PC Paintbrush
PDF	Portable Document Format table
PGM	Portable GrayMap format
PGN	Portable GrayMap format
PI1	Atari Degas .pi1 Format
PI3	Atari Degas .pi3 Format
PIC	Apple Macintosh QuickDraw/PICT
PLOT	Unix Plot(5) format
PNG	Portable Network Graphics
PNM	Portable anymap
PPM	Portable pixmap
PPT	Powerpoint
PRT	PRT ray tracer image
PS1	Adobe PostScript, level 1
PS2	Adobe PostScript, level 2
PSD	Adobe Photoshop
QRT	QRT ray tracer
RAD	Radiance image
RAS	CMU raster image format
RGB	Raw red, green, and blue bytes
RGBA	Raw red, green, blue, and matt bytes
RLE	Utah Run length encoded image
SGI	Silicon Graphics
SIR	Solitaire file format
SIXL	DEC sixel color format
SLD	AutoCADA slide filea
SPC	Atari compressed Spectrum file
SPOT	SPOT satelite images
SUN	SUN Rasterfile
TGA	Targa True Vision
TIF	Tagged Image Format
TIL	Tile image with a texture
TXT	Raw text
UIL	Motif UIL icon file
UPC	Universal Product Code bitmap
UYVY	YUV bit/pixel interleaved (AccomWSD)
VIC	Video Image Communication and Retrieval (VICAR)
VID	Visual Image Directory
VIF	Khoros Visualization image
WRL	Virtual reality modeling language
X1BM	X10 bitmap
XBM	X11 bitmap
XCC	Constant image of X server color
XIM	XIM file
XPM	X11 pixmap
XWD	X Window system window Dump
XXX	Image from X server screen
YBM	Bennet Yee ``face" file
YUV	Abekas Y- and U- and Y-file
YUV3	Abekas Y- and U- and Y-file, 3

	ZEIS	Zeiss confocal file
	ZINC	Zinc bitmap
Facsimile	--	See Table 25
Reserved	--	See Table 20

Conclusion

This invention supports an indefinite number of formal objects. At the current time, supported objects are parent-child encoding, 1D and 2D barcoding, and a reasonably sized schemata. The invention's means of classification and archive notation is sufficiently flexible to be used in a variety of imaging situations shown. The examples given are meant to provide illustrations only and not to be limiting with respect to the types of imaging situations to which the present invention might apply.

The rules and notations specified in the preceding tables provide a basis for universal image enumeration encoding, decoding, and processing suitable for development of diverse implementations of the invention.

ASIA

The present invention is implemented in a variety of hardware embodiments. Common to these embodiments is the ability of the equipment to process information(i.e. a CPU of some type is required, a means for entering data satisfying the require syntax is necessary (i.e. some form of user data entry in the form of a keyboard, optical reader, voice entry, point-and-click, or other data entry means), a built-in encoding mechanism or some form of data storage means to hold, at least

temporarily the data input by the user, a data recording means in order to process the information and output a barcode or other graphical representation of data.

Processing flow

Referring to Figure 7 the processing flow of ASIA is shown.

Command 701 is a function call that accesses the processing to be performed by ASIA

Input format 703 is the data format arriving to ASIA. For example, data formats from Nikon, Hewlett Packard, Xerox, Kodak, etc., are input formats.

ILF (705,707, and 709) are the Input Language Filter libraries that process input formats into ASIA-specific format, for further processing. For example, an ILF might convert a Nikon file format into an ASIA processing format. ASIA supports an unlimited number of ILFs.

Configuration 711 applies configuration to ILF results. Configuration represents specifications for an application, such as length parameters, syntax specifications, names of component tables, etc.

CPF (713,715, and 717) are Configuration Processing Filters which are libraries that specify finite bounds for processing, such pre-processing instructions applicable to implementations of specific devices. ASIA supports an unlimited number of CPFs. Processing 719 computes output, such as data converted into numbers.

Output format 721 is a structured output used to return

processing results.

OLF (723, 725, 727) are Output Language Filters which are libraries that produce formatted output, such as barcode symbols, DBF, Excel, HTML, L^{A}TEX, tab delimited text, WordPerfect, etc. ASIA supports an unlimited number of OLFs.

Output format driver 729 produces and/or delivers data to an Output Format Filter. OFF (731, 733, 735) are Output Format Filters which are libraries that organize content and presentation of output, such as outputting camera shooting data, database key numbers, data and database key numbers, data dumps, device supported options, decoded number values, etc. ASIA supports an unlimited number of OLFs.

Numeric ranges

ASIA uses indefinite numeric ranges for all of its variables except date, which supports years 0000-9999. ASIA provides default values for the numeric ranges, which represent a preferred embodiment, and are not meant to be limiting. Indeed the present invention can accommodate additional values depending upon the implementation selected. And the current ranges and values can be easily extended, depending upong the needs of specific implementation.

Location numbers. Location numbers track any number of generation, any number of lots, and date to the day. Optionally, location numbers track time to any granularity of accuracy, any number of concurrent authors, any number of devices, any number of images in an archive, any number of

additional data for future extensibility, and any number of additional data for user customization.

Image numbers. Image numbers track any number of imaging categories (2 defaults), any number of media sizes (47 defaults); any number of push settings or any number of dynamic range ("bit depth") settings, keyed by format; any number of transparency media types (60 defaults), any number of negative media types (115 defaults), any number of print media types (209 defaults), any number of packages (90 defaults), and any number of digital formats (159 defaults); any unit of resolution; any number of stain (presentation) forms (9 defaults); and any number of image formats (12 defaults). Finally, image numbers optionally support any number of additional data for future extensibility, and any number of additional data for user customization.

Parent numbers. Parent numbers track parent conception date. Since an archive can have any number of images, an archive also contains any number of parents. Parent numbers optionally support any unit of additional data for future extensibility, and any unit of additional data for user customization.

All variables use unbounded value ranges except for the variable *date*, which supports years 0000-9999. Table 8 **Variables with unbounded ranges** specifically identifies unbounded variables, organized by type of number **(Number)**, category of functionality **(Category)**, and corresponding variable **(Variable)**.

Syntactic rules guarantee consistency across all implementations; see **Syntax: Tables 10-11** above. No matter how differently implementations are customized, all implementations that are compliant with the encoding scheme described herein will exchange data.

Number	Category	Variable
location	number of generations	*generation*
location	number of lots in an archive	*sequence*
location	number of units in a lot	*unit*
location	number of authors	*author*
location	number of devices	*device*
location	granularity of time accuracy	*time*
location	specification extensibility	*locationRes*
location	user customization	*locationCus*
image	number of categories	*category*
image	number of media	*media*
image	number of software packages	*set*
image	number of stains	*stain*
image	number of formats	*format*
image	range of push settings	*push*
image	range of bit depth	*bit*
image	range of size	*size*
image	range of resolution	*resolution*
image	specification extensibility	*imageRes*
image	user customization	*imageCus*
parent	granularity of time accuracy	*parent*
parent	specification extensibility	*parentRes*
parent	user customization	*parentCus*

Table 8: Variables with unbounded ranges

Examples. More specifically, 4 examples will illustrate ASIA's interoperability. All of these examples use a 4 digit *sequence* definition (i.e., supporting 9,999 lots), but each example adjusts the *unit* definition and employs the optional variables *device* and/or *author*. Values of *device* and *author* are adjusted irregularly across the examples.

Example. Using 36 unit lots, useful for traditional 35mm

photography, this creates an upper bound of 359,964 images per archive (or 7,199 images a year for 50 years). 1 digit device encoding is used supporting up to 10 concurrently used devices.

Example. Using 99 unit lots, useful for digital imaging, this creates an upper bound of 989,901 images per archive (or 19,798 images a year for 50 years). 2 digit device encoding is used supporting up to 100 concurrently used devices.

Example. Using 9,999 unit lots, useful for photocopy imaging, this creates an upper bound of 100 million (99,980,001) images per archive (or 2 million [1,999,600] images a year for 50 years). 3 character author encoding is used supporting up to 676 concurrent authors in the archive, device is unspecified.

Example. Using 999,999 unit lots, suitable for motion imaging, this creates an upper bound of 9,998,990,001 (10 trillion) images per archive (or 200 million [199,979,800] images a year for 50 years). 4 character author encoding is used supporting up to 456,976 concurrent authors; and 3 digit device encoding is used supporting up to 1000 concurrently used devices per author.

Data from all of the above example can be seamlessly shared using the encoding scheme of the present invention.

Parent-child Processing

Implementation. ASIA provides native support of parent

decoding and is written to support parent encoding. However, since parent-child encoding functionality must operate directly with resolvers (see Figure 3) multi-generation encoding is left to device specific implementations.

ASIA implements parent-child support through the 'schemata' and 'engine' components of the Figure 5 **Implementation** through extensive use of OLF's (See Figure 7 ASIA).

Barcode Processing

Implementation. ASIA natively supports 1D Code 39 and 2D Data Matrix barcodes. ASIA implements barcoding through the 'engine' component of the implementation.

Code Instantiation

The ASIA engine library specifically implements the invention's formal requirements for classification and archival notation and in this sense provides a reference implementation of the invention's relations.

ASIA is written in ANSI C++, with flexibility and performance improving extensions for Win32 and SVID compliant UNIXes. It has been developed to work as a library for inclusion into other software, or as a core engine to which interfaces are written. ASIA is modularized into small, convenient encoding and decoding filters (libraries): ILFs, CPFs, OLFs, and OFFs. To create a full implementation, a developer often needs only to write 1 filter of each variety. These filters are simple, sometimes a few lines of code each.

Such extensibility is designed to permit rapid porting of ASIA to diverse applications. For example, with minimal effort, a programmer may port ASIA to a new device or software package. With little or no customization, the ASIA engine library may plug into pre-existing applications, serve as a back-end for newly written interfaces, or be included directly into chips with tabular information maintained through Flash ROM upgrades, etc. ASIA illustrates all 3 layers of the invention, as characterized in Figure 1. Specifically, ASIA provides a robust set of native functionality in a core code offering. The core code has been developed for extreme, rapid, and convenient extensibility. ASIA's extensibility provides theoretically unlimited interoperability with devices, mechanisms, and software, while requiring absolutely minimal development effort and time.

It is expected that ASIA subsumes the functionality needed by most applications for which the Automated System for Image Archiving applies, but ASIA itself merely is one implementation of the invention's formal specifications presented in §4.2.

Utility

For the author, devices that implement this invention can provide a convenient, accurate, and flexible tracking system that builds cumulatively and automatically into a comprehensive, rationally organized archival system that required no archival knowledge whatsoever to use. This can

reduce many administrative needs facing those who use image-producing devices. Similarly, after a user initializes the systems, the system will work without user intervention.

For example, the need for photographic assistants could be curtailed in professional photography. Using a device constructs an archive without human intervention, and clicking a barcode reader on an image displays image data.

For the archivist, mechanisms implementing this invention can automate exact and rapid tacking of every image in a given archive, for inventory/sales, author identification, historical record, etc. For example, an advertising agency could recall client information and image production facts from a click of a barcode reader. A newspaper could process, identify, and track images from its photographic staff through automated slide sorting machines. Museums could automate collection and inventory services as a matter of course in receiving new materials.

For the manufacturer, implementations of this invention can provide devices with automated encoding, decoding, and processing systems, included in chips or accompanying software. A device can produce self-identifying enumeration which interoperates with other devices by the same manufacturer, or with other devices from other manufacturers.

For example, a manufacturer could provide consumers with a seamless mechanism to track image evolutions, from film developing to digital editing to paper production. Or

hospitals could automatically track patient x-rays and MRI scans as a matter of course in using the equipment. The equipment could be manufactured by one or different manufacturers, and the system would work seamlessly for the end-user.

I Claim:

1. A system for universal image tracking comprising:
An image forming apparatus;
A CPU integral to the image forming apparatus;
User input means connected to the CPU for receiving user input;
Logic stored in the CPU for receiving user input and creating archive data based upon the user input; and
A Graphic code producer responsive to the CPU for producing graphic codes representative of the archive data.

2. The system for universal image tracking of claim 1 wherein the image forming apparatus is a film based camera.

3. The system for universal image tracking of claim 1 wherein the image forming apparatus is a digital based camera.

4. The system for universal image tracking of claim 1 wherein the image forming apparatus is a video camera.

5. The system for universal image tracking of claim 1 wherein the image forming apparatus is a digital image processor.

6. The system for universal image tracking of claim 1 wherein the image forming apparatus is a medical image sensor.

7. The system for universal image tracking of claim 6 wherein the medical image sensor is a magnetic resonance imager.

8. The system for universal image tracking of claim 6 wherein the medical image sensor is an X-ray imager.

9. The system for universal image tracking of claim 6 wherein

the medical image sensor is a CAT scan imager.

10. The system for universal image tracking of claim 1 wherein the user input means is a push button input.

11. The system for universal image tracking of claim 1 wherein the user input means is a keyboard.

12. The system for universal image tracking of claim 1 wherein the user input means is voice recognition equipment.

13. The system for universal image tracking of claim 1 wherein the graphic codes are one-dimensional.

14. The system for universal image tracking of claim 1 wherein the graphic codes are two-dimensional.

15. The system for universal image tracking of claim 1 wherein the graphic codes are three-dimensional.

16. The system for universal image tracking of claim 1 wherein the logic comprises configuration input processing for determining bounds for the archive data generation based on configuration input;

a resolver for determining the correct value of archive data representing the image forming apparatus and the configuration input; and

a timer for creating date/time stamps.

17. The system for universal image tracking of claim 16 wherein the timer further comprises a filter for processing the time stamp according to configuration input rules.

18. The system for universal image tracking of claim 16

wherein the configuration input comprises at least generation, sequence, data, unit, and constants information.

19. The system for universal image tracking of claim 1 further comprising a graphic code reader connected to the CPU for reading a graphic code on an image representing archive information; and

A decoder for decoding the archive information represented by the graphic code.

20. The system for universal image tracking of claim 19 wherein the logic further comprises:

logic for receiving a second user input and creating lineage archive information relating to the image based upon the archive information and the second user input; and

logic for producing graphic code representative of the lineage archive data.

21. The system for universal image tracking of claim 1 wherein the archive data comprises location attributes of an image.

22. The system for universal image tracking of claim 1 wherein the archive data comprises physical attribute of an image.

23. The system for universal image tracking of claim 1 wherein each image in an image archive has unique archive data associated with each image.

24. The system for universal image tracking of claim 21

wherein the location data comprises at least:
image generation depth;
serial sequence of lot within an archive;
serial sequence of unit within a lot;
date location of a lot within an archive;
date location of an image within an archive;
author of the image; and
device producing the image.

25. The system for universal image tracking of claim 16 wherein the timer tracks year in the range of from 0000 to 9999.

26. The system for universal image tracking of claim 16 wherein the timer tracks all 12 months of the year.

27. The system for universal image tracking of claim 16 wherein the timer tracks time in at least hours and minutes.

28. The system for universal image tracking of claim 16 wherein the timer tracks time in fractions of a second.

29. The system for universal image tracking of claim 16 wherein the system is ISO 8601:1988 compliant.

30. The system for universal image tracking of claim 22 wherein the physical attributes comprise at least:
image category;
image size;
push status;
digital dynamic range;

image medium;
image resolution;
image stain; and
image format.

31. The system for universal image tracking of claim 20 wherein the lineage archive information comprises a parent number.

32. The system for universal image tracking of claim 31 wherein the parent number comprises at least:
a parent conception date; and
a parent conception time.

33. A method for universally tracking images comprising: inputting raw image data to an image forming apparatus; inputting image-related data; creating first archive data based upon the image-related data; and translating the first archive data into a form that can be attached to the raw image data.

34. The method for universally tracking images of claim 33 wherein the raw image data is from a film based camera.

35. The method for universally tracking images of claim 33 wherein the raw image data is from a digital camera.

36. The method for universally tracking images of claim 33 wherein the raw image data is from a video camera.

37. The method for universally tracking images of claim 33 wherein the raw image data is from a digital image processor.

38. The method for universally tracking images of claim 33 wherein the raw image data is from a medical image sensor.

39. The method for universally tracking images of claim 38 wherein the medical image sensor is a magnetic resonance imager.

40. The method for universally tracking images of claim 38 wherein the raw image data is from an X-ray imager.

41. The method for universally tracking images of claim 38 wherein the raw image data is from a CAT scan imager.

42. The method for universally tracking images of claim 33 wherein the inputting image related data occurs without user intervention.

43. The method for universally tracking images of claim 33 wherein the inputting of image related data occurs via push button input.

44. The method for universally tracking images of claim 33 wherein the inputting of image related data occurs via voice recognition equipment.

45. The method for universally tracking images of claim 33 wherein the inputting of image related data occurs via a keyboard.

46. The method for universally tracking images of claim 33 wherein the form of the translated archive data is an electronic file.

47. The method for universally tracking images of claim 33 wherein the form of the translated data is a graphic code.

48. The method for universally tracking images of claim 47 wherein the graphic code is one dimensional.

49. The method for universally tracking images of claim 47 wherein the graphic code is two dimensional.

50. The method for universally tracking images of claim 47 wherein the graphic code is three dimensional.

51. The method for universally tracking images of claim 33 wherein the image data comprises image data and second archive data.

52. The method for universally tracking images of claim 33 further comprising reading the second archive data; and creating lineage archive information relating to the image based upon the first archive information and second archive information.

53. The method for universally tracking images of claim 33 wherein the inputting of image related data comprises configuration input processing for determining bounds for the archive data generation based upon configured input; determining the correct value of archive data representing the image forming apparatus and configuration input; and date/time stamping the image related data.

54. The method for universally tracking images of claim 53 wherein date/time stamping is filtered according to configuration input rules.

55. The method for universally tracking images of claim 33 wherein the configuration input comprises at least

generation, sequence, data, unit, and constants information.

56. The method for universally tracking images of claim 33 wherein the first archive data comprises location attributes of an image.

57. The method for universally tracking images of claim 33 wherein the first archive data comprises physical attributes of an image.

58. The method for universally tracking images of claim 56 wherein the location attributes comprise at least:
image generation depth;
serial sequence of lot within an archive;
serial sequence of unit within a lot;
date location of a lot within an archive;
date location of an image within an archive;
author of the image; and
device producing the image.

59. The method for universally tracking images of claim 57 wherein the physical attributes of an image comprise at least:
image category;
image size;
push status;
digital dynamic range;
image medium;
software set;

image resolution;

image stain; and

image format.

60. The method for universally tracking images of claim 52 wherein the lineage archive information comprises a parent number.

61. The method for universally tracking images of claim 52 wherein the parent number comprises at least:

a parent conception date; and

a parent conception time.

62. The system for universal image tracking of claim 1 wherein the input means comprises a magnetic card reader.

63. The system for universal image tracking of claim 1 wherein the input means comprises a laser scanner.

64. The system for universal image tracking of claim 31 wherein the physical attributes further comprise;

imageRes; and

imageCus.

65. The method for universally tracking images of claim 33 wherein the inputting image related data is via a magnetic card reader.

66. The method for universally tracking images of claim 33 wherein the inputting of image related data is via a laser scanner.

67. The method of universally tracking images of claim 33 wherein the inputting of image related data is via an

optical reader.

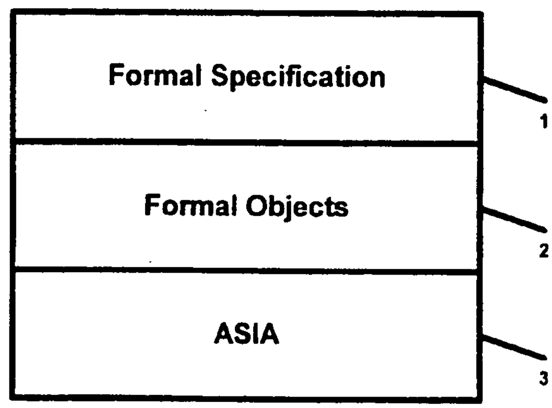

Figure 1

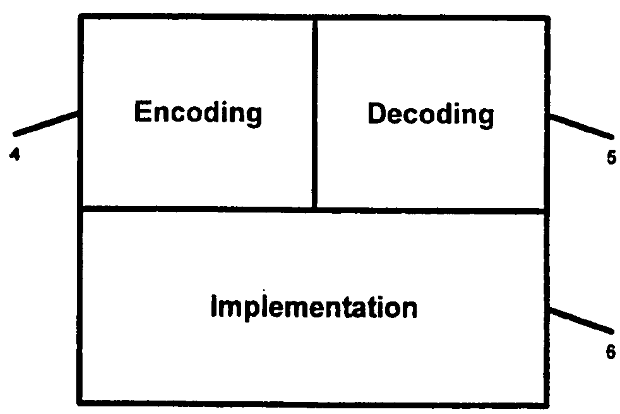

Figure 2

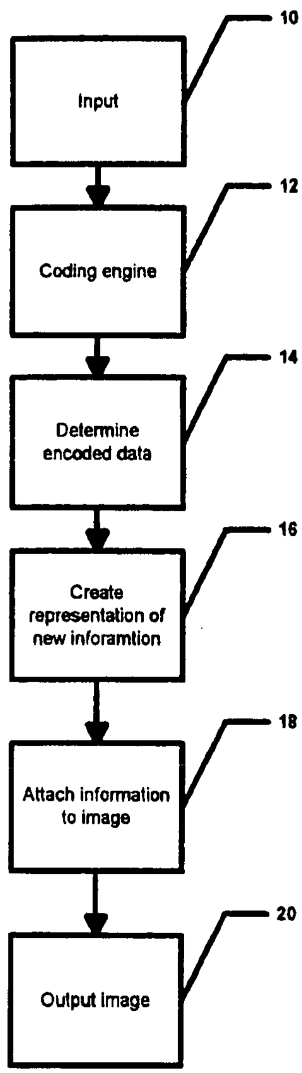

Figure 1A

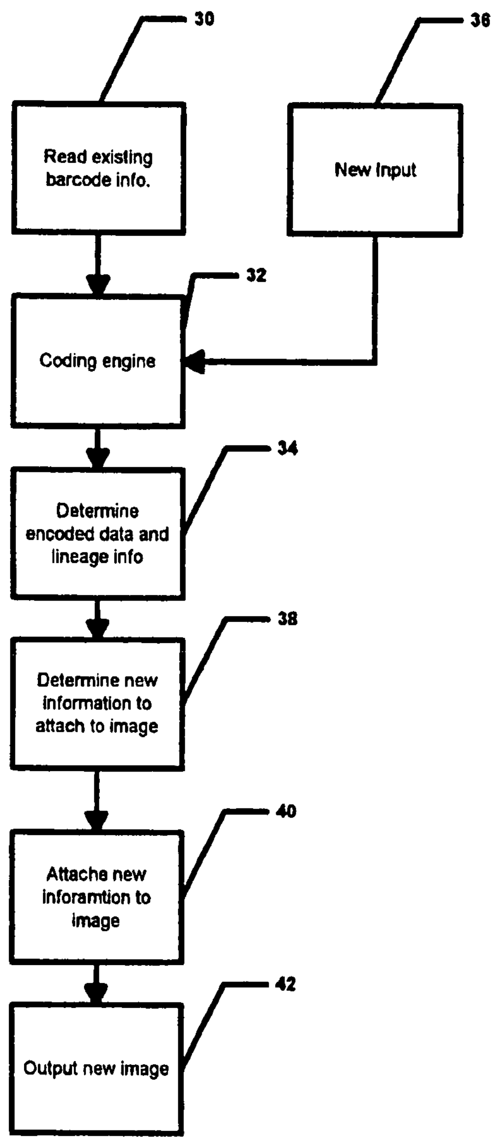

Figure 1B

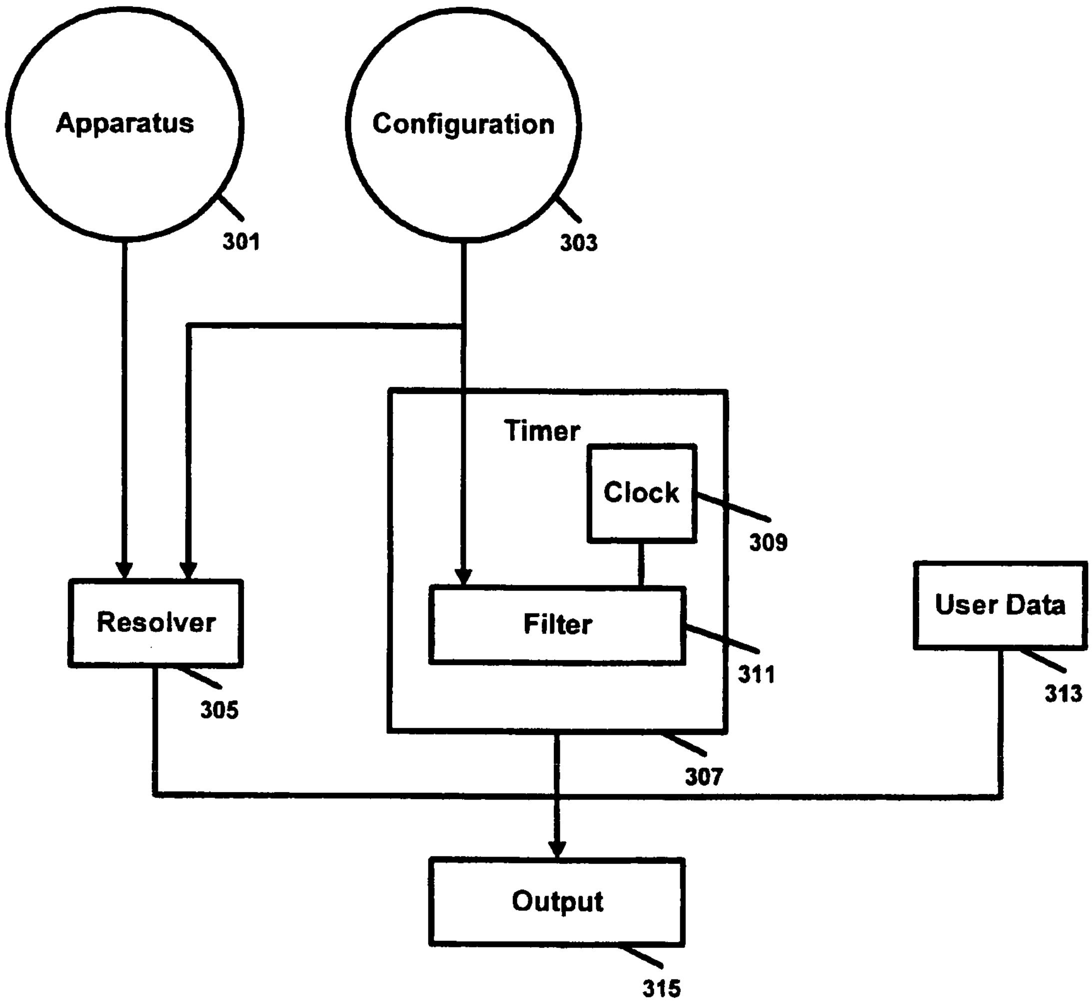
Apparatus
Configuration
301
303
Timer
Clock
309
Resolver
Filter
User Data
311
305
313
307
Output
315

Figure 3

```
// Location identifying information
location  ➜  generation sequence time-stamp author device locationRes locationCus

// Physical attribute information
image     ➜  category size bit-or-push media set resolution stain format imageRes imageCus

// Parent identifying information
parent    ➜  time-stamp parentRes parentCus
```

Figure 4

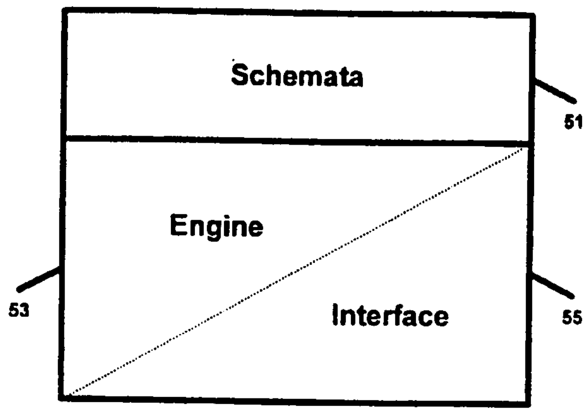

Figure 5

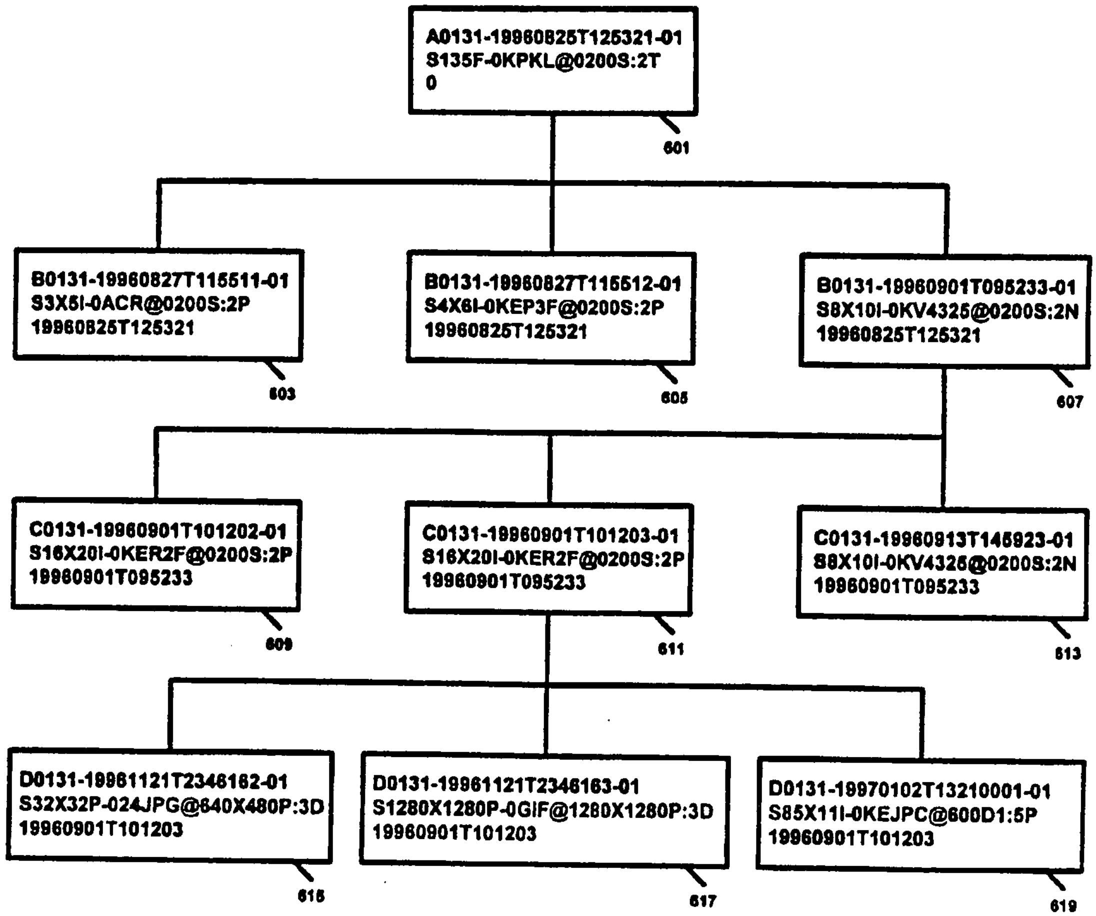
A0131-19960825T125321-01
S135F-0KPKL@0200S:2T
0
601
B0131-19960827T115511-01
S3X5I-0ACR@0200S:2P
19960825T125321
603
B0131-19960827T115512-01
S4X6I-0KEP3F@0200S:2P
19960825T125321
605
B0131-19960901T095233-01
S8X10I-0KV4325@0200S:2N
19960825T125321
607
C0131-19960901T101202-01
S16X20I-0KER2F@0200S:2P
19960901T095233
609
C0131-19960901T101203-01
S16X20I-0KER2F@0200S:2P
19960901T095233
611
C0131-19960913T145923-01
S8X10I-0KV4325@0200S:2N
19960901T095233
613
D0131-19961121T2346162-01
S32X32P-024JPG@640X480P:3D
19960901T101203
615
D0131-19961121T2346163-01
S1280X1280P-0GIF@1280X1280P:3D
19960901T101203
617
D0131-19970102T13210001-01
S85X11I-0KEJPC@600D1:5P
19960901T101203
619

Figure 6

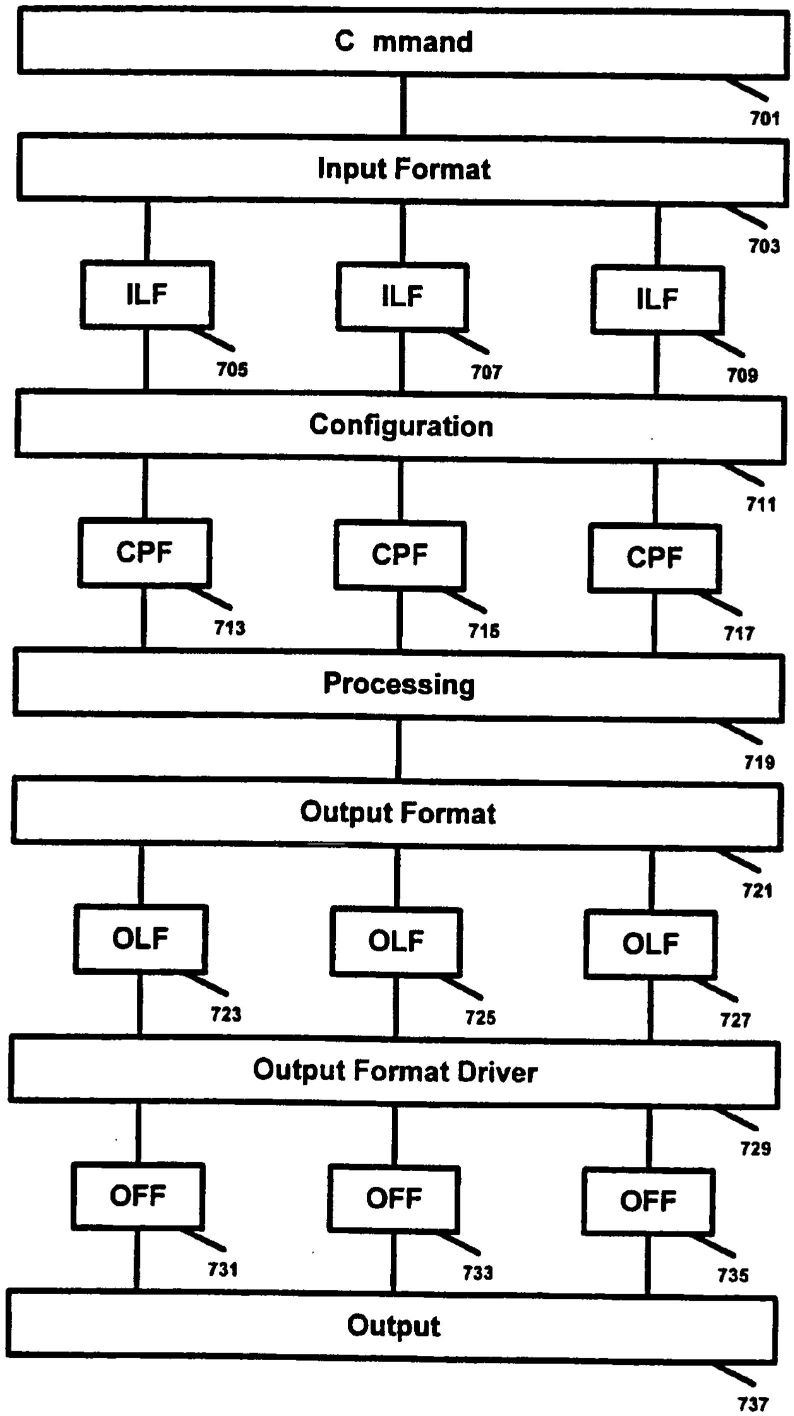
C mmand
701
Input Format
703
ILF
ILF
ILF
705
707
709
Configuration
711
CPF
CPF
CPF
713
715
717
Processing
719
Output Format
721
OLF
OLF
OLF
723
725
727
Output Format Driver
729
OFF
OFF
OFF
731
733
735
Output
737

Figure 7

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/00624

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N1/21

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 568 161 A (XEROX CORP) 3 November 1993	1,33
A	see the whole document	1,16,23, 53

Y	US 5 008 700 A (OKAMOTO TSUGIO) 16 April 1991 cited in the application	1,33
A	see abstract	47

A	US 5 193 185 A (LANTER DAVID) 9 March 1993 cited in the application see abstract	1,33

	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 May 1998	25/05/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hazel, J

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/00624

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	CALLAGHAN V L ET AL: "STRUCTURES AND METRICS FOR IMAGE STORAGE AND INTERCHANGE" JOURNAL OF ELECTRONIC IMAGING, vol. 2, no. 2, 1 April 1993, pages 126-137, XP000369378 see Section 2.2 ---	1,22,23, 30,33, 46,53, 57,59
A	WO 86 05610 A (ALPHAREL INC) 25 September 1986 see abstract -----	1,23,33

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 98/00624

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 5193185 A	09-03-1993	NONE	
WO 8605610 A	25-09-1986	US 4665555 A	12-05-1987
		AU 577451 B	22-09-1988
		AU 5458486 A	13-10-1986
		EP 0217825 A	15-04-1987
		JP 62502638 T	08-10-1987